# CONCURRENT SCHEDULE PERFORMANCE OF POSSUMS: A COMPARISON OF TWO MODELS

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## ABSTRACT

These experiments examined the behaviour of brushtail possums (*Trichosurus vulpecula*) under concurrent variable-interval schedules of reinforcement. In the first experiment the lever pressing of six possums resulted in intermittent access to a barley/carob mixture under four pairs of variable-interval schedules. In most respects, the behaviour of the possums was similar to that observed with other species. However, the degree of undermatching of the response ratios to the obtained reinforcement-rate ratios was greater than is normally observed with these schedules. Both the Generalised Matching Law and the Contingency-Discriminability model described the data well, although, where overmatching was obtained, the parameter values given by the Contingency-Discriminability model did not make sense in terms of the original assumptions of the model. The second experiment examined the possibility that the undermatching related to the length of the changeover delay used. Six possums were exposed to five different pairs of concurrent schedules at each of four different changeover-delay lengths (ranging from 0 to 6 s). Time allocation and post-changeover delay responses more closely approximated matching with a 2-s changeover delay than with a 0-s delay, but no further changes in sensitivity were observed with further increases in changeover-delay length. Overmatching was consistently observed in the post-changeover delay data, resulting in un-interpretable parameter values from Contingency-Discriminability analyses. The addition of the punishment parameter ($w$) to the Contingency-Discriminability model, suggested to deal with such data, did not generally result in more sensible parameter estimates. The third experiment attempted to bias possums responding using qualitatively different reinforcers. Equal variable-interval schedules were used with the barley/carob mixture available on one schedule and Cocopops™ or coconut on the other. Possums' behaviour was biased by these foods, with a small bias away from the barley/carob mixture resulting from the Cocopops and a large bias towards the barley/carob mixture resulting from the coconut. In the fourth experiment, graded point estimates of bias were obtained by presenting four different concentrations of salted barley/carob mixture (ranging from 0% to 6%) on one schedule and plain

barley/carob mixture on the other schedule. Small biases were found with 0% and 2% salt, and large biases were found towards the barley/carob mixture with 4% and 6% salt. To assess whether bias remains constant with changes in the reinforcer-rate ratio, further conditions were conducted with 4% and 6% salt, with four pairs of unequal concurrent variable-interval schedules. Analyses of these data with both the Generalised Matching Law and the Contingency-Discriminability Model revealed an interaction between bias and the reinforcement-rate ratio. This interaction may be due to an improvement in discriminability due to the different reinforcers. The behaviour of the possums was generally well described by both the Generalised Matching Law and the Contingency-Discriminability model. Overall, neither model was better at describing behaviour under the above conditions, although several problems were found with the application of the Contingency-Discriminability model.

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The brushtail possum (*Trichosurus vulpecula*) was first introduced into New Zealand from Australia in the 1800's to establish a fur industry (Pracy & Kean, 1969). Soon after their introduction, there were complaints about the damage they were doing to gardens and orchards (Pracy & Kean, 1969). However, no action was taken at this time, as it was thought that the benefits of the fur industry would far outweigh any damage caused. Over the years, the amount of damage caused by possums has become progressively more apparent (Pracy & Kean, 1969; Swan, 1996).

Today, possums contribute to a large range of problems, including the defoliation of both native and exotic tree species (Fitzgerald, 1981; Pracy & Kean, 1969; Swan, 1996). Possums cause further damage to trees by biting the bark to mark their territory, and they sometimes use bark as a food source (Pracy & Kean, 1969). This forest destruction affects the native bird populations by destroying their habitats. Possums have also been known to eat eggs and young birds (Swan, 1996). As well as contributing to the destruction of New Zealand's forests, possums have been implicated in the transfer of tuberculosis to cattle and deer (Julian, 1981). The possums' immunity to this disease is deficient, making them highly susceptible (Swan, 1996).

The possum population in New Zealand was estimated to have reached approximately 70 million by 1992 (Seitzer, 1992). The success of the possum population in New Zealand compared to Australia has been attributed to the lack of both predators and competition for food sources (Swan, 1996). For all of these reasons, possum control is a topic of major concern to the community.

Little research has been done on possums' psychophysical and learning abilities. Such research could provide information helpful in developing more efficient possum control measures. One important area of study is possum food preferences, and the identification of odours and/or flavours that possums prefer. Knowledge of such preferences, and of appropriate methods for assessing them, could then be used to help design baits that are attractive to possums.

There have been very few preference studies of any sort with possums. Those that have been done have involved presenting the possums with two or

more alternatives simultaneously, and then observing their behaviour towards each (Hudson, Foster & Temple, 1999; Morgan, 1990; Todd, 1995). Todd (1995) examined odour preferences by attaching jars containing synthetic odours to the front of the possum's cages, and observing the amount of time spent sniffing each jar. Todd (1995) found no preference for any of the odours over distilled water (i.e., possums spent approximately the same amount of time sniffing each jar). These odours were also tested in an enclosure, and as lures to traps in the wild. No odour preferences were observed in either of these situations. Todd suggested that a different result may have been achieved if naturally occurring odours had been used rather than synthetic odours.

Hudson et al. (1999) and Morgan (1990) studied the food preferences of possums. Morgan (1990) added flavours to barley and measured the consumption of each flavoured barley. Each trial included the pairing of one of three different flavoured barleys with unflavoured barley. In most trials, more unflavoured than flavoured barley was eaten by the possums. More flavoured than unflavoured barley was eaten with only 14 of the 40 flavours presented. The consumption of only one flavour (orange) was significantly greater than the consumption of unflavoured barley. Hudson et al. (1999) presented possums with pairs of different foods. The subjects were allowed to eat only one food from each pair, and preference was determined by the percentage of times that each food was selected. Although clear preferences were found with this method, it was not possible to determine 'how much' the possum preferred one food over another (Hudson et al., 1999).

## Concurrent Schedules

The preferences of several species have been studied using schedules of reinforcement, in which a consequence, termed a reinforcer (usually food), is made contingent on responding. The response selected depends on the species, but is normally one which operates a key or lever. The most commonly used schedules in such studies of preference have been variable-interval (VI) schedules (e.g., Hollard & Davison, 1971; Matthews & Temple, 1979; McAdie, Foster &

Temple, 1996), in which food is made available for the first response emitted after a predetermined period of time has elapsed since the last food presentation, which varies around some average value. For example, a VI 40-s schedule would deliver reinforcement for the first response, on average, after 40 s had elapsed since the previous reinforcement. To measure a subject's preference, two alternatives (each associated with a VI schedule of reinforcement) are made available at the same time. This is termed a concurrent VI VI schedule of reinforcement procedure (Ferster & Skinner, 1957). The most common way of arranging concurrent schedules involves offering two independent response alternatives (e.g., two keys) located next to each other. Each key is associated with a different schedule of reinforcement, and the subject is free to respond on either alternative at any time during a session.

Concurrent schedules can be programmed either independently or dependently. Under independent schedules, once a reinforcer becomes available on one alternative, the timer for that alternative pauses until that reinforcer has been collected. During this time, provided a reinforcer is not due on the alternate schedule, its timer will continue. Under these conditions, it is possible for the subject to respond exclusively on one of the alternatives and to continue to receive reinforcement from that alternative. Under dependent schedules, when a reinforcer becomes available on either of the schedules, the timers for both schedules stop and do not restart until the scheduled reinforcer has been collected. Dependent schedules allow the experimenter to control the proportion of reinforcement received on the alternatives. They also ensure that responding is maintained on both alternatives, because exclusive responding on one alternative will result in extinction on that alternative (i.e., no reinforcers will become available). In a review of concurrent-schedule research, Taylor and Davison (1983) presented the results of several experiments involving both dependent and independent concurrent VI VI schedules of reinforcement. Overall, the behaviour observed appeared similar irrespective of the type of schedules used.

The Generalised Matching Law

Behaviour under concurrent VI VI schedules of reinforcement is most commonly analysed using the Generalised Matching Law (GML; Baum, 1974). Expressed logarithmically, it is:

$$\log (B_1/B_2) = a \log (r_1/r_2) + \log c \qquad (0.1)$$

where $B_1$ and $B_2$ represent the number of responses made, or the times spent on the two alternatives, and $r_1$ and $r_2$ represent the rate of reinforcer delivery obtained from the two alternatives. Plotting $\log (B_1/B_2)$ against $\log (r_1/r_2)$ gives a straight line (matching line), where the slope, $a$, is a measure of the sensitivity of behaviour to changes in the relative rate of reinforcement, and the $y$-intercept, $\log c$, is a measure of bias towards one of the alternatives over and above reinforcement-rate differences.

Strict matching ($a = 1.0$, $\log c = 0$) implies that the ratio of responses made on each alternative equals the ratio of reinforcers obtained on those alternatives. There are two common types of deviation from strict matching described by Baum (1979). The first occurs when $a$ is not equal to 1.0. When $a$ is less than 1.0, the subject's responding tends towards indifference (i.e., the amount of behaviour allocated to the schedule providing the greater rate of reinforcement (the rich schedule) is less than that predicted by strict matching). This is referred to as undermatching. Overmatching results when the subject responds more on the rich schedule than predicted by strict matching, and is indicated by an $a$ value of greater than 1.0.

Undermatching, with $a$ values usually around 0.8 (Baum, 1979; Davison & McCarthy, 1988; Williams, 1988), is the most common result in studies using a GML analysis. Undermatching has been demonstrated in humans (Mace, Neef, Shade & Mauro, 1994), cows (Foster, Temple, Robertson, Nair & Poling, 1996; Matthews & Temple, 1979), goats (Foster, Matthews, Temple, & Poling 1997), horses (Dougherty & Lewis, 1992), rats (Baum, 1979; Wearden & Burgess, 1982), hens (Temple, Scown, & Foster, 1995), and pigeons (Davison & Hunter, 1976; Hollard & Davison, 1971).

One suggestion is that undermatching is related to the length of the changeover delay (COD) used (Baum, 1979; de Villiers, 1977; Shull & Pliskoff, 1967). A COD is a period of time after switching response alternatives during which no reinforcers will be delivered, even if one has been set up by the VI schedule. COD's are usually added to concurrent VI VI schedules to establish independence between the two schedules, and to prevent accidental reinforcement for switching schedules (Catania, 1966).

Introducing a COD has the effect of decreasing the number of changeovers within a session (Findley, 1958). It has been suggested that the presence of a COD also increases the sensitivity of behaviour to reinforcement (Baum, 1979; Shull & Pliskoff, 1967). Temple et al. (1995) studied the behaviour of hens over a range of COD values and reinforcement-rate ratios. They found that the observed *a* values increased from the no-COD condition to the 2-s COD condition, but remained relatively constant with further increases in COD length, suggesting that the presence of a COD may be more important than the length. Responding within the COD was also found to be insensitive to changes in the reinforcement-rate ratios. This finding is common (e.g., McAdie et al., 1996; Muir, 1997; Silberberg & Fantino, 1970), and provides support for Baum's (1982) suggestion that only responses made outside the COD (i.e., post-COD responses) should be analysed.

The second type of deviation from strict matching, termed bias, is seen when log *c* does not equal zero, and arises from a subject's responding consistently more on one alternative, independent of reinforcement rate. This bias can be what is termed inherent bias, for example, due to a colour or position preference. However, bias can also be experimentally arranged by setting up different response requirements (e.g., Sumpter, Foster & Temple, 1995; Sumpter, Temple & Foster, 1998), by providing qualitatively different reinforcers on the two alternatives (e.g., Matthews & Temple, 1979; Miller, 1976), by arranging a delay to reinforcement (Chung & Herrnstein, 1967), or by varying the amount of reinforcement (Todorov, 1973). Such a procedure can give a measure of the degree of 'preference' for the different response or reinforcer types over and above

inherent bias.

Using concurrent VI VI schedules, two qualitatively different reinforcers can be made available, each associated with its own response key and schedule of reinforcement. Hollard and Davison (1971) suggested that differences in the qualities of the reinforcers would be demonstrated by an intercept not equal to zero (i.e., $\log c \neq 0$). They found that pigeons exhibited large biases towards the schedule delivering food reinforcers when the other schedule delivered brain stimulation. In that study, no measure of inherent bias was recorded, so it is possible that the bias found was not entirely due to the relative qualities of the different reinforcers.

When attempting to study the food preferences of cows (hay vs. dairy meal), Matthews and Temple (1979) suggested two separate sources of bias and a modification of the GML. In logarithmic form, it is:

$$\log (P_1/P_2) = a \log (r_1/r_2) + \log (q_1/q_2) + \log b \qquad (0.2)$$

where $\log b$ is the inherent bias, $q_1$ and $q_2$ are the qualities of the foods, P is equivalent to B in Equation 0.1, and $\log (q_1/q_2) + \log b$ is equal to $\log c$ in Equation 0.1. Preference was then determined by first arranging the same food on each alternative to obtain a measure of $\log b$, then presenting different foods on each alternative. By subtracting $\log b$ from the total bias measure, the amount of bias due solely to food preference was then determined. A similar method has also been used successfully to study preference between crushed barley and meat meal with cows (Foster et al., 1996), between different grains with pigeons (Miller, 1976), to determine the aversiveness of different noises in hens (McAdie et al., 1996), and to study the behaviour of hens using different response types and force requirements (Sumpter et al., 1995; Sumpter et al., 1998).

The GML provides a good description of behaviour on concurrent VI VI schedules of reinforcement both with and without introduced biasers. Therefore, provided possums respond similarly to other animals under such schedules, the GML will be a suitable model to attempt to study their behaviour.

The Contingency-Discriminability Model

Another model, which was proposed as an alternative to the GML for describing concurrent-schedule performance, is Davison and Jenkins' (1985) Contingency-Discriminability (C-D) model. Expressed mathematically, it is:

$$B_1/B_2 = c(d_r R_1 + R_2)/(d_r R_2 + R_1) \quad (0.3)$$

where $B_1$ and $B_2$ are the same as in Equation 0.1, $R_1$ and $R_2$ are equivalent to $r_1$ and $r_2$ in Equation 0.1, $c$ is a measure of bias, and $d_r$ is a measure of the discriminability of the response-reinforcer contingencies. In other words, $d_r$ measures how well a subject can discriminate which of the alternatives the response that gave rise to each reinforcer was made on, and therefore, what schedules are in effect. If the subject is unable to make this discrimination, $d_r$ will have a value of 1.0, while as the subjects' ability to discriminate the response-reinforcer contingencies improves, the value of $d_r$ will approach infinity (perfect discrimination). Data which give rise to $a$ values around 1.0 when analysed using the GML will give $d_r$ values that approximate infinity when analysed using Davison and Jenkins' (1985) C-D model. This model assumes, therefore, that any undermatching obtained when data are analysed using the GML is actually the result of less than perfect discrimination between the response-reinforcer contingencies.

A modified version of Equation 0.3 was used by Davison and Jones (1995) and Jones and Davison (1998), and is:

$$B_1/B_2 = c(R_1 - pR_1 + pR_2)/(R_2 - pR_2 + pR_1) \quad (0.4)$$

where $p$ represents the proportional confusion between the two reinforcer contingencies. When $p$ is equal to zero, there is said to be no confusion between the two VI schedules (i.e., discriminability is perfect, $d_r$ = infinity), while when $p$ is equal to 0.5 there is said to be complete confusion between the two VI schedules (i.e., the subject is unable to discriminate between the alternatives, $d_r = 1$). This model assumes that the subjects' behaviour perfectly matches the 'perceived' reinforcer-rate ratio at all times, but that a proportion of reinforcers

delivered are mistakenly associated with the incorrect alternative, resulting in a failure to match according to the arranged reinforcer-rate ratio.

When the C-D equation is plotted on logarithmic co-ordinates (i.e., log $(B_1/B_2)$ vs. log $(R_1/R_2)$) and discrimination is less than perfect, the resulting line is ogival (e.g., Jones & Davison, 1998) with the behaviour-allocation ratio becoming more different from that predicted when discrimination is perfect as the reinforcer-rate ratio is made more extreme. When discrimination is perfect, the line is straight with a slope of 1.0 (as is the case with matching when using the GML). As with the GML, bias is indicated by a *y*-intercept not equal to zero.

Very few studies have looked at how well the C-D model deals with concurrent-schedule data. Davison and Jenkins (1985) fitted the model to the data from Miller, Saunders and Bourland (1980). That study examined the effects of changing stimulus disparity in a switching-key concurrent VI VI procedure. The stimuli consisted of single lines with varying degrees of separation (ranging from 0° to 45°). Miller et al. (1980) reported that as stimulus disparity was increased (i.e., the stimuli were made more different), the sensitivity of response allocation to changes in the reinforcer-rate ratio increased (indicated by an increase in *a* values in the GML). Davison and Jenkins (1985) found that $d_r$ also increased with stimulus disparity, suggesting that as the stimuli became more different, the ability of the subject to discriminate between the associated schedules improved. Alsop and Davison (1991) examined the effects of stimulus disparity using a switching-key concurrent-schedule procedure and different intensities of white light as the stimuli. They reported that values of $d_r$ increased with stimulus disparity (for both response- and time-allocation measures). Alsop and Davison (1991) concluded that their results were conceptually more consistent with the C-D model than the GML, since the C-D model provides an explanation of why stimulus discriminability might be expected to have an effect on response- and time-allocation.

Davison and Jenkins (1985) predicted that analyses using their C-D model would not differ from analyses using the GML when the reinforcer-rate ratio was varied between 0.1:1 and 10:1, which according to Davison and Jenkins

is the range used in most experiments. However, they stated that beyond this range, the C-D model predicts more extreme response- or time-allocation ratios than the GML. Davison and Jones (1995) studied the behaviour of pigeons with extreme reinforcer-rate ratios (up to 160:1) using a switching-key procedure. Five of the nine concurrent VI VI schedule pairs used had reinforcer-rate ratios of less than 10:1. The GML was fitted to the data from these five schedule pairs only, as well as to the data from all nine of the schedule pairs. The *a* values obtained from these two analyses differed for all subjects, ranging from 0.36 to 0.6 when all conditions were analysed, and from 0.48 to 0.71 when only the five schedule pairs with the least extreme reinforcer-rate ratios were used. Davison and Jones (1995) presented the above results as evidence that the GML is unable to describe behaviour on concurrent schedules of reinforcement accurately, since the difference in *a* values from the two analyses suggests that the relationship between the logarithms of the response and reinforcer-rate ratios is not linear.

When Davison and Jones (1995) analysed the above data using the C-D model, only one analysis, using the data from all of the schedule pairs, was done. The reason given for not comparing C-D analyses using the data from the five least extreme reinforcer-rate ratio conditions with C-D analyses using the data from all conditions was that the parameters of this model "are mainly determined by the end points" (Davison & Jones, 1995, p. 152). If the C-D model is to be considered 'better' than the GML however, analyses using only the central data and analyses using all of the data should give very similar results. However, Davison and Jones did not carry out such an analysis. Nevertheless, the deviations of the extreme data points from the line predicted using the central data with the GML were given as support for using the C-D model instead of the GML.

Davison and Jones (1995) also compared the obtained response ratios to those predicted by each equation. Smaller differences between these were found from analyses using the C-D model than from analyses using the GML. It should be noted that the GML analysis used in that study was based on the fit to the five least extreme conditions, and therefore did not provide a direct comparison of the

predictive abilities of the two models. Nonetheless, Davison and Jones (1995) concluded that this provided further support for the C-D model.

A stated advantage of the C-D model over the GML is that it provides a good description of behaviour on concurrent VI extinction (VI EXT) schedules (Davison & Jenkins, 1985). The GML predicts that responding on such schedules will always occur exclusively on the VI schedule alternative (irrespective of values of $a$ and log $c$), however Davison and Jenkins (1985) reported that this result is uncommon. If $R_2$ is equal to zero, as is the case under concurrent VI EXT schedules, the C-D model reduces to:

$$B_1/B_2 = cd_r \tag{0.5}$$

and therefore predicts exclusive responding only when the discriminability measure is infinite, or in other words, the subject's discrimination of the response-reinforcer contingencies is perfect (Davison & Jenkins, 1985).

Davison and Hunter (1976) studied behaviour using several three-alternative concurrent schedules in which the schedule on one or two of the alternatives was extinction. In all but three of the instances where extinction was arranged, the subjects continued to respond on that alternative, although the rate of responding was very low. Davison and Jones (1995) conducted one condition using a concurrent VI EXT schedule. In that condition all subjects continued responding on the extinction alternative. The data obtained from the other concurrent VI VI schedule pairs were used to calculate the expected ratio of responding under concurrent VI EXT schedules according to the C-D model (i.e., $cd_r$). For 5 of the 6 subjects, the obtained ratio of responding on the VI alternative was greater than that predicted based on the subjects' performances on the other schedule pairs (i.e., responding was less extreme (closer to matching) than predicted). Because some responding occurred on the extinction alternative, this was given as evidence against the GML for describing concurrent-schedule behaviour. Davison and Jones argued that the results supported the use of the C-D model, even though it was not able to predict responding on concurrent VI EXT schedules accurately. Davison and Jones (1998) also conducted several

concurrent VI extinction conditions. While exclusive responding did occur during some sessions, this result did not occur consistently within any of the conditions. Davison and Jones (1998) therefore concluded that the C-D model is more appropriate for the analysis of concurrent-schedule data than the GML.

One limitation of the C-D model is that it does not predict, and cannot describe, overmatching. This result can, however, be described using a GML analysis. While the finding of overmatching is not particularly common, any model which attempts to describe concurrent-schedule behaviour should have the ability to deal with all possible data. Davison and Jenkins (1985) attempted to get around this problem in two ways. Firstly, they suggested that models of punishment such as those proposed by de Villiers (1980) and Farley (1980) could be used in conjunction with the C-D model to explain the occurrence of overmatching when a changeover requirement is in effect (such as a COD or fixed-ratio (FR) schedule) and responses during the changeover requirement are not included in the analysis. Secondly, they stated that overmatching is actually the result of statistical error. In other words, the true value of $a$ is actually less than or equal to 1.0, but is not given as such due to chance variation in the data. The second of these presumably only applies when no changeover requirement is used, or when the behaviour during the changeover is included in the analysis.

Davison and McCarthy (1994) studied behaviour using a three-alternative switching-key concurrent-schedules procedure with a 3-s blackout following each CO response. Overmatching was observed for all subjects with $a$ values ranging from 1.08 to 1.55. Because, as stated above, the C-D model is unable to cope with overmatching, they presented a version of the model with a punishment parameter included, as suggested by Davison and Jenkins (1985):

$$B_1/B_2 = c(d_r R_1 + R_2 - w)/(d_r R_2 + R_1 - w) \tag{0.6}$$

or

$$B_1/B_2 = c(p_r R_1 + (1 - p_r)R_2 - w)/(p_r R_2 + (1 - p_r)R_1 - w) \tag{0.7}$$

where $w$ is the number of reinforcers lost per minute due to changing over, and $p_r$

is the relative discriminability ($d_r = p_r/(1 - p_r)$). In this form, when $p_r$ is equal to 0.5, the subject is unable to discriminate ($d_r = 1$), and when $p_r$ is equal to 1, discrimination is perfect ($d_r$ = infinity). This model described their data well, giving $p_r$ values close to 1.0 for all subjects. However, $p_r$ values greater than 1.0 and less than 0.5 were observed in several cases. The values of $w$ ranged from 0.02 to 0.24. Generally $w$ was smaller when the $a$ values were larger (i.e., when subjects were overmatching more).

The percentages of variance accounted for by the data when the C-D model was used in the above studies were similar to those usually found using a GML analysis. This suggests that the C-D model is as good at describing concurrent-schedule behaviour as the GML. Analyses using both the C-D model and the GML show that performance on concurrent schedules 'improves' as stimulus disparity increases (indicated by increasing $a$ or $d_r$ values). In fact, it is expected that changes in $d_r$ will always follow changes in $a$, at least over the range of reinforcer-rate ratios usually used (Davison & Jenkins, 1985). Why then, should we start using the C-D model for describing concurrent-schedule behaviour? Davison and Jenkins (1985) suggested that the parameter, $d_r$, in their model is conceptually better than the parameter, $a$, in the GML because 'sensitivity to reinforcement' ($a$) gives no real explanation for why undermatching might occur, whereas they suggested that it can be seen how decreases in contingency discriminability, or increases in confusability, could lead to poorer 'matching' by the subject.

Since strict matching was first found (Herrnstein, 1961, 1970) many models have been proposed in an attempt to account for the commonly observed deviations from strict matching. Ideally, a suitable model for this should have the following attributes:

1. The model should fit the data well. In other words, the percentage of variance accounted for (%VAC) should be high.
2. The parameters of the model should be logical and defensible. This relates to the story behind the model. It is important that there be a good reason for the inclusion of parameters in a model.

3. The inclusion, or not, of parameters should depend on arguments, not on a failure to fit the data. In other words, the reasons for including a parameter should be based on theory, not on data.
4. The parameter values obtained should be reasonable in terms of the original assumptions. If the parameters have a set range of logically required values, fitting the data should not give values outside this range.
5. Ideally, the model should be predictive of changes in the data with changes in the experimental conditions. In other words, when changing the experimental procedure results in changes in the data (or indeed, fails to change the data) the model should be able to predict, and therefore, possibly explain such changes.

One of the aims of this thesis will be to examine how suitable the GML and the C-D model are for describing concurrent VI VI schedule behaviour, based on the above attributes. Another focus of the present thesis is to examine the ways in which experimentally introduced biasers will affect possums' behaviour, and how well these models account for such behaviour.

Previous research has shown that the GML appears to cope well with experimentally introduced biasers (e.g., Foster et al., 1996; McAdie et al., 1996; Miller, 1976; Sumpter et al., 1995; Sumpter et al., 1998). However, how well the C-D model deals with introduced biases (such as different foods) is an area that has not yet been addressed. Before attempting to study food preferences with possums using the GML and the C-D model, it was necessary to determine if possums behave similarly to other animals when exposed to concurrent schedules of reinforcement.

There is only one study of possums' behaviour under concurrent schedules. Muir (1997) obtained choice data with possums using multiple concurrent VI VI schedules of reinforcement. This involved presenting two schedules on separate levers for a 10-min period with green lights presented above the levers, then reversing the schedules for a further 10-min period, with red lights above the levers. The different coloured lights are intended to enable the subjects

to discriminate between the two components of the session. This method of obtaining matching lines is slightly more time-efficient than having only one pair of schedules in effect each session. Nevertheless, Muir (1997) found that the possums' behaviour was unusually insensitive to reinforcement-rate changes using this procedure, as demonstrated by the slopes of the matching lines obtained for both response (*a* values ranged from 0.15 to 0.38) and time (*a* values ranged from 0.36 to 0.65) measures.

Muir (1997) suggested several possible explanations for the large amount of undermatching observed. One was that possums were not able to discriminate between the red and green lights that were used. There are presently no data available on whether possums can see, or distinguish between, red and green. However, studies currently under way at the University of Waikato's Animal Behaviour and Welfare Research Centre suggest that possums are unable to discriminate between bright and dim lights using either red or green coloured LED's (Signal, personal communication), indicating that some other form of discriminative stimuli may be necessary for multiple-concurrent schedule research. If the possums could not discriminate between the coloured lights, the possums' behaviour could not come under the control of the stimuli. If this was the case, Muir's study could be seen to show support for the C-D model, in that the low sensitivity to reinforcement was due to poor discriminability between the response-reinforcer contingencies. Another possibility was that the 2-s COD she used was too short, and that if this had been lengthened, a closer approximation to matching may have been obtained. Thus, although Muir described possums' behaviour under multiple concurrent schedules of reinforcement, it was not clear whether their behaviour would be similar to that observed with other animals under simple concurrent schedules of reinforcement. Therefore further research into possum behaviour on concurrent VI VI schedules of reinforcement was required.

The first experiment examined possums behaviour under simple concurrent VI VI schedules of reinforcement. The next experiment examined the effects of increasing the length of the COD on possums' behaviour, and looked at

how well the Generalised Matching Law and the Contingency-Discriminability model described such data. The following experiment looked at whether it was possible to bias possums' behaviour with qualitatively different reinforcers using equal schedules of reinforcement. The final experiment studied the effects of qualitatively different reinforcers on behaviour over a range of reinforcer-rate ratios, and how well the Generalised Matching Law and the Contingency-Discriminability model described the data.

# EXPERIMENT 1

The present experiment was a partial replication of Muir's (1997) experiment. In this case, simple concurrent schedules of reinforcement were used. Each schedule was associated with a different lever and only one pair of schedules was used for a number of consecutive sessions, in contrast to the multiple components used by Muir. If possums have problems discriminating between the schedules of reinforcement, then it is possible that exposure time in each session might increase differentiation. Muir used components of only 10-min duration, and found extreme undermatching, providing some justification for this idea. Therefore, data from the first and second half of the session will be examined here. The same group of possums used by Muir were used for this experiment to enable direct comparisons of the data from the two procedures.

## Method

### Subjects

Five common brushtail possums were used as subjects. Four of the possums were male, and one was female. The possums were named George, Arthur, Timmy, Holly and Sylvester. All possums had prior experience on multiple concurrent VI VI schedules of reinforcement (Muir, 1997). The possums were maintained at a stable body weight by daily feeding of dock leaves and apples, and by supplementary feeding of pellets (NRM NZ Ltd) when necessary. They were weighed every two weeks to judge the stability of their weights and to ensure that adequate food was being provided. All possums had a constant supply of water.

The possums were exposed to reverse daylight conditions, since they are nocturnal. This made it possible to conduct experimental sessions during the day. Two standard 100-150-W light bulbs were on between the hours of 6 pm and 6 am, simulating daylight. During experimental sessions, which ran from approximately 8 am to 8:40 am, the only illumination in the room was provided

by two 60-W red light bulbs. For the rest of the time the room was in darkness. A heater was present in the room, and the temperature was maintained at between 14 and 21°C.

Apparatus

The subjects' home cages also served as experimental chambers. Each cage measuring 860 mm x 510 mm x 540 mm, was constructed of galvanised steel grid and had a wood nest-box attached to the top where the subjects slept. Access to each of the cages was via a plywood door (550 mm x 330 mm), located 70 mm from the floor of the cage. The experimental equipment was also located on the door, and consisted of two amber lights (28-V bulbs covered with an amber filter), positioned 360 mm from the bottom of the door and 200 mm apart. A slot where a lever could be inserted was located 80 mm below each light. Levers were inserted only during the experimental sessions to prevent damage by the possums. An electronic beeper located at the top and centre of the outside of the door provided auditory feedback when an effective response was made on either of the levers. An effective lever response required a minimum force of 0.25 N. Three of the cages (2, 4 and 6) had a button located on the top left-hand corner of the door, which was used to start experimental sessions for the possums in these cages and their left-hand neighbour (cages 1, 3 and 5 respectively).

Food reinforcers were presented via a food magazine attached to the door of the cage. The magazine could be raised to present food to the possums through a hole (130 mm x 100 mm) in the door, 180 mm below the levers. When lowered, the subjects were unable to reach the food. Reinforcement consisted of 3-s access to steam-flaked barley and carob chips mixed in the ratio of 15:1.

All experiments were run using a 386 IBM-compatible computer equipped with a MED-PC™ interface and software. This was located in the experimental room. The computer collected and stored the experimental data, which were also copied into a data book.

Procedure

Concurrent VI VI schedules were dependently arranged on the left and right levers. Inter-reinforcement intervals were initially calculated for a VI 15-s schedule (an arithmetic series with 15 intervals, a smallest interval of 1 s, and a largest interval of 29 s), and these numbers were adjusted to the size of the required schedule (e.g., for a VI 30-s schedule, each number would be multiplied by 2), and randomly arranged in a series. The same quasi-random series of intervals was used every session, with the starting point randomly determined prior to the beginning of each session.

At the beginning of each session, and following the insertion of the levers, both lever lights were illuminated, and the subjects could respond on either lever. When a response resulted in reinforcement, the lights were extinguished, and the food magazine was presented for a period of 3 s. At the conclusion of a reinforcer, the food magazine was lowered, and the lever lights came back on. Whenever a subject switched levers, a COD of 2 s began, timed from the first response on the lever. During this time, the subject could respond, but no reinforcement was available. All experimental sessions lasted for 40 mins. Sessions were run five days per week (Monday through Friday).

The experiment consisted of four conditions, using three different pairs of schedules: concurrent VI 40-s VI 40-s, concurrent VI 180-s VI 22.5-s, and concurrent VI 22.5-s VI 180-s schedules. Table 1.1 shows the order of the conditions, as well as the number of sessions in each condition. Each condition was in effect until the behaviour of all possums had reached stability. Stability was determined statistically by calculating the median of the proportion of left responses for each five-day period, and comparing this to the median for the previous five-day period. Stability was reached when these medians differed by .05 or less, five, not necessarily consecutive, times. Stability was also assessed visually, by plotting the proportion of left responses across sessions, and once statistical stability was reached, these data were checked for any trends. If the data appeared to be trending, the condition continued until responding was visually stable, as judged by two or more lab members.

Table 1.1
The order of conditions for Experiment 1, the schedules in effect, and the number of sessions required to reach stability in each condition.

| | VI Schedules (s) | | |
|---|---|---|---|
| Condition | Left | Right | Sessions |
| 1 | 40 | 40 | 26-41 |
| 2 | 22.5 | 180 | 22 |
| 3 | 180 | 22.5 | 29 |
| 4 | 40 | 40 | 37 |

The computer recorded the number of responses made on each lever, the number of reinforcers obtained on each lever, the time spent responding on each lever (in seconds), the time to the first response (in milliseconds), the total post reinforcement-pause time (in seconds) associated with each lever (during Conditions 3 and 4 only), the number of changeovers and the number of responses made during the changeover delay. In every condition, these measures were recorded at the end of the session. During Conditions 2, 3 and 4, they were also recorded halfway through the session. In addition, cumulative data were recorded during Conditions 3 and 4. This included the time of every response, as well as the time of every reinforcer. Cumulative data were recorded separately for each lever.

## Results

The raw data from the last five sessions of Conditions 1 to 4 are presented in Appendix A. All analyses were carried out on the data summed across these five sessions. All ratios were taken to the left manipulandum and all logarithms are to the base 10.

### Generalised Matching Law

Figure 1.1 shows the logarithms of the ratios of the numbers of responses (left panel) and of the ratios of the times (right panel) allocated to each lever, plotted against the logarithms of the obtained reinforcer ratios for each possum and each condition. The data presented here were analysed using the GML. The solid lines plotted through the points on each graph represent the lines of best fit calculated by least-squares regression analyses. The equations at the bottom of each graph describe these regression lines. The slopes and intercepts of each of these lines, as well as the percentages of variance accounted for by each of the lines (%VAC) and the standard errors of the estimates (SE) are presented in Table 1.2. For comparison, the dotted lines on each graph have a slope of 1.0 and a y-intercept of 0, indicating strict matching.

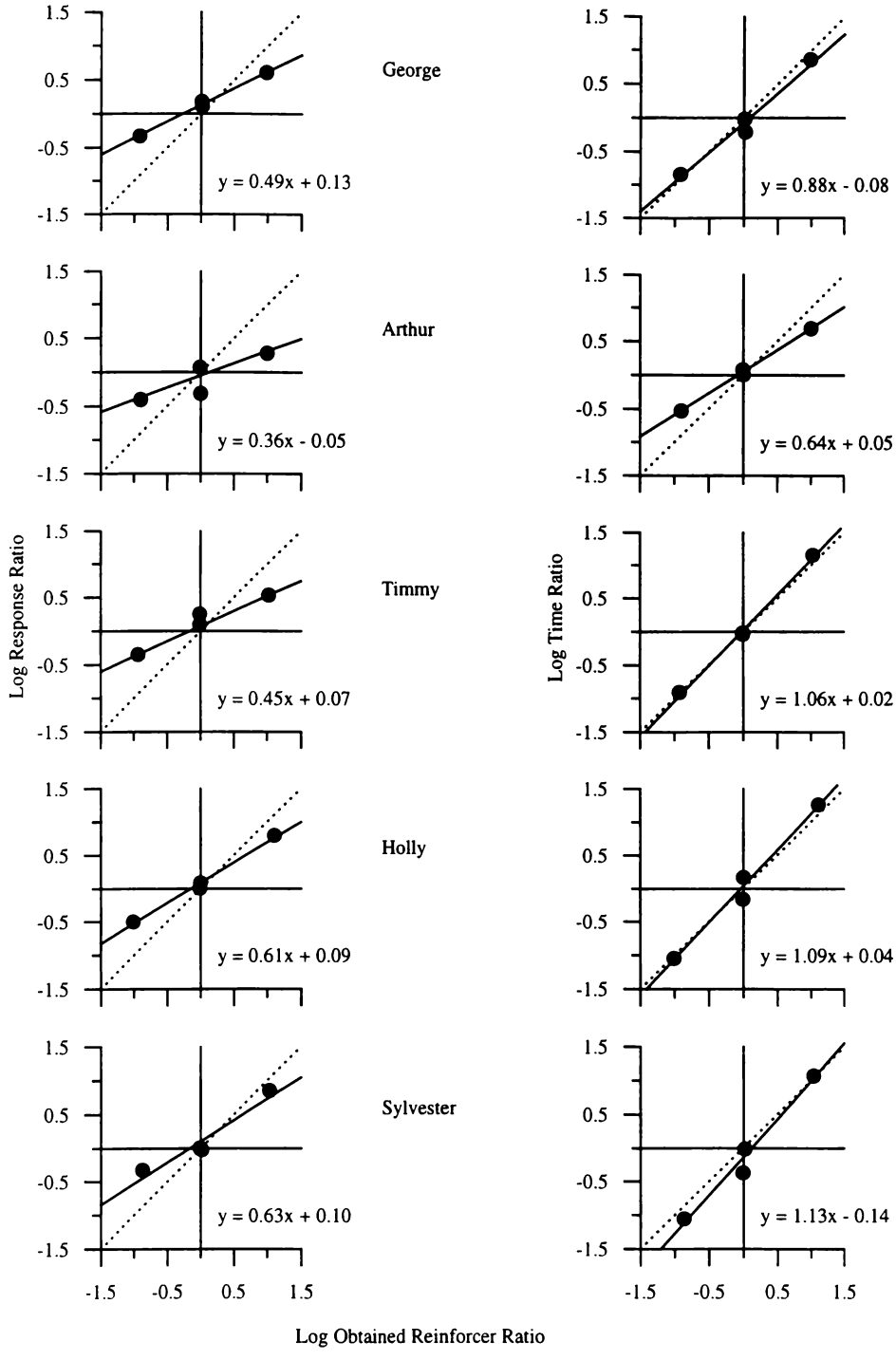


Figure 1.1. The logarithms of the response ratios (left) and the logarithms of the time-allocation ratios (right) plotted as functions of the logarithms of the obtained reinforcer ratios.

Table 1.2

The slopes ($a$), y-intercepts (log $c$), the percentage of variance accounted for (%VAC) and standard errors of the estimates (SE) for the lines of best fit for total response and time allocation (Figure 1.1), within- and post-COD responding (Figure 1.2), and first- and second-half response and time allocation (Figure 1.3). Slopes and y-intercepts are also given for PRP- and Net-time allocation (Figure 1.7) where only two data points were collected.

| | Slope | Intercept | | | Slope | Intercept | | | Slope | Intercept | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Possum | ($a$) | (log $c$) | %VAC | SE | ($a$) | (log $c$) | %VAC | SE | ($a$) | (log $c$) | %VAC | SE |
| | Total Responses | | | | First Half Responses | | | | Second Half Responses | | | |
| George | 0.49 | 0.13 | 99.3 | 0.04 | 0.53 | 0.13 | 99.7 | 0.04 | 0.46 | 0.16 | 99.6 | 0.04 |
| Arthur | 0.36 | -0.05 | 90.9 | 0.11 | 0.38 | 0.00 | 96.4 | 0.10 | 0.34 | -0.05 | 90.5 | 0.14 |
| Timmy | 0.45 | 0.07 | 99.3 | 0.04 | 0.49 | 0.08 | 99.5 | 0.04 | 0.42 | 0.03 | 99.9 | 0.02 |
| Holly | 0.61 | 0.09 | 99.1 | 0.06 | 0.59 | 0.08 | 99.4 | 0.07 | 0.68 | 0.08 | 98.6 | 0.12 |
| Sylvester | 0.63 | 0.10 | 93.4 | 0.16 | 0.66 | 0.14 | 96.2 | 0.17 | 0.58 | 0.16 | 96.2 | 0.16 |
| MEAN | 0.51 | 0.07 | 96.4 | 0.08 | 0.53 | 0.09 | 98.2 | 0.08 | 0.50 | 0.08 | 97.0 | 0.10 |
| | Total Time | | | | First Half Time | | | | Second Half Time | | | |
| George | 0.88 | -0.08 | 98.1 | 0.12 | 0.90 | -0.07 | 100.0 | 0.01 | 0.86 | 0.00 | 100.0 | 0.01 |
| Arthur | 0.64 | 0.05 | 99.6 | 0.04 | 0.67 | 0.08 | 100.0 | 0.01 | 0.62 | 0.05 | 99.8 | 0.04 |
| Timmy | 1.06 | 0.02 | 99.6 | 0.06 | 1.05 | 0.05 | 99.5 | 0.10 | 1.08 | 0.01 | 99.9 | 0.06 |
| Holly | 1.09 | 0.04 | 98.0 | 0.16 | 0.96 | 0.05 | 99.8 | 0.06 | 1.26 | -0.06 | 97.6 | 0.29 |
| Sylvester | 1.13 | -0.14 | 97.3 | 0.18 | 1.07 | -0.11 | 99.3 | 0.11 | 1.19 | -0.26 | 96.5 | 0.32 |
| MEAN | 0.96 | -0.02 | 98.5 | 0.11 | 0.93 | 0.00 | 99.7 | 0.06 | 1.00 | -0.05 | 98.7 | 0.14 |
| | Within COD | | | | Post COD | | | | PRP Time | | Net Time | |
| | | | | | | | | | Slope ($a$) | Intercept (log $c$) | Slope ($a$) | Intercept (log $c$) |
| George | 0.09 | 0.44 | 62.3 | 0.07 | 0.76 | -0.09 | 98.8 | 0.08 | 0.91 | -0.07 | 0.85 | -0.01 |
| Arthur | 0.05 | -0.12 | 7.3 | 0.16 | 0.49 | -0.02 | 92.8 | 0.13 | 0.68 | 0.08 | 0.68 | 0.08 |
| Timmy | -0.11 | -0.03 | 73.0 | 0.06 | 0.78 | 0.07 | 98.4 | 0.10 | 1.04 | 0.02 | 0.85 | -0.10 |
| Holly | 0.15 | 0.18 | 28.8 | 0.25 | 0.79 | -0.02 | 98.7 | 0.10 | 0.81 | -0.17 | 0.96 | -0.11 |
| Sylvester | 0.04 | 0.28 | 4.3 | 0.19 | 1.01 | -0.09 | 98.5 | 0.12 | 1.12 | -0.03 | 0.71 | -0.47 |
| MEAN | 0.04 | 0.15 | 35.1 | 0.15 | 0.77 | -0.03 | 97.4 | 0.11 | 0.91 | -0.03 | 0.81 | -0.12 |

The data obtained from the two equal concurrent-schedule conditions were similar for all subjects. The mean difference between the logarithms of the response ratios from the two equal-schedule conditions was -0.02, while the mean difference between the logarithms of the time ratios was 0.10. The response data from all subjects show a large amount of undermatching, with the slopes of the regression lines ranging from 0.36 to 0.63 (mean = 0.51). By comparison, the time data more closely approximated matching, with evidence of both undermatching and overmatching (slopes from 0.64 to 1.13; mean = 0.96). In all cases, the slopes of the lines describing the time data were greater than those describing the response data. The intercepts of the lines describing both the response and time data were small, ranging from -0.05 to 0.13 for responses (mean 0.07) and from -0.14 to 0.05 for times (mean = -0.02), indicating only small amounts of inherent bias. Four of the 5 subjects' behaviour (the exception being Arthur) was biased towards the left manipulandum in terms of response-allocation (intercept greater than zero). In terms of time measures, 3 possums (Arthur, Timmy and Holly) exhibited a bias towards the left lever, while the other 2 subjects' behaviour was biased towards the right lever.

The response and time data were well described by the regression lines. The proportions of variance accounted for by the regression lines were high for all subjects, with a lowest %VAC of 90.9%, and means of 96.4% and 98.5% for responses and time respectively. The standard errors of the estimates (SE) were low, averaging 0.08 and 0.11 for responses and time respectively.

Figure 1.2 shows both the logarithms of the ratios of responses made within the COD (left panel) and the ratios of responses made after the COD (right panel) plotted against the logarithms of the obtained reinforcer-rate ratios for all possums. Again, a GML analysis was used here. Lines of best fit were calculated using least-squares regression, and are shown on both sets of graphs (solid lines). The slopes and intercepts of these lines, together with the percentages of variance accounted for (%VAC), and the standard errors of the estimates (SE) are also presented in Table 1.2. Within-COD responding was relatively insensitive to the differences in the reinforcement rates for all subjects, with slopes ranging from

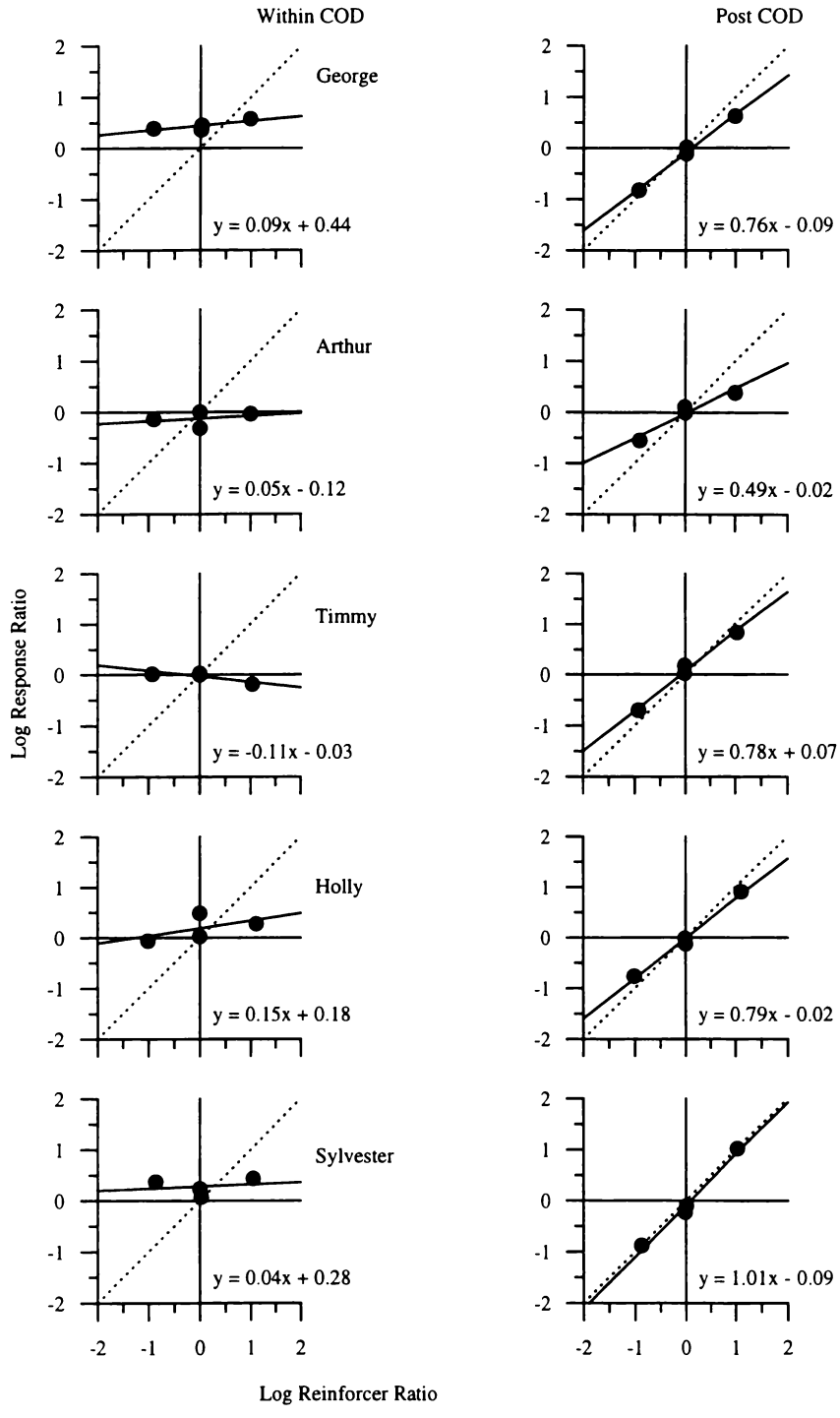


Figure 1.2. The logarithms of the response ratios within and after the changeover delay plotted as a function of the logarithms of the obtained reinforcer ratios.

-0.11 to 0.15 (mean = 0.04). In contrast, there was only a small amount of undermatching in the post-COD data for most subjects, with slopes ranging from 0.49 to 1.01 (mean = 0.77). For all subjects, the slopes of the lines describing the post-COD data were greater than those describing the total response measures, while those describing the within-COD data were consistently lower than those describing the total response measures. The within-COD bias measures (intercepts ranging from -0.12 to 0.44) were always greater than the post-COD bias measures (-0.09 to 0.07). For all but 1 subject (the exception being Timmy), the within-COD bias measures were greater than the overall bias measures, and for these 4 subjects both biases were in the same direction. The post-COD biases were all smaller than, and were sometimes in the opposite direction from, the overall response biases.

The percentages of variance accounted for by the lines describing the post- COD data (mean = 97.4%) were comparable to those describing the overall response measures. The %VAC by the lines describing the within-COD data were relatively low, with a mean of 35.1%, and were consistently lower than the %VAC by the lines describing the total response data. Due to the shallow slopes of the lines describing within-COD responding, the %VAC values are artificially reduced. In such cases, the standard errors of the estimates offer a better description of the fits of the lines to the data. The standard errors of the estimates were low for all subjects for both within- (maximum = 0.25; mean = 0.15) and post-COD responding (maximum = 0.13; mean = 0.11), and were similar to those obtained for overall responding.

The logarithms of the ratios of the total responses (left panel) and times (right panel) allocated to each lever during the first (unfilled circles) and second (pluses) half of the session are plotted against the logarithms of the obtained reinforcer ratios for each subject in Figure 1.3. Data from the first equal VI VI schedule condition are not included here, as only total session data were recorded in that condition. The dotted lines on each graph represent strict matching. The solid lines are the regression lines calculated using a GML analysis from the data from the first half of the session. The dashed lines are the regression lines

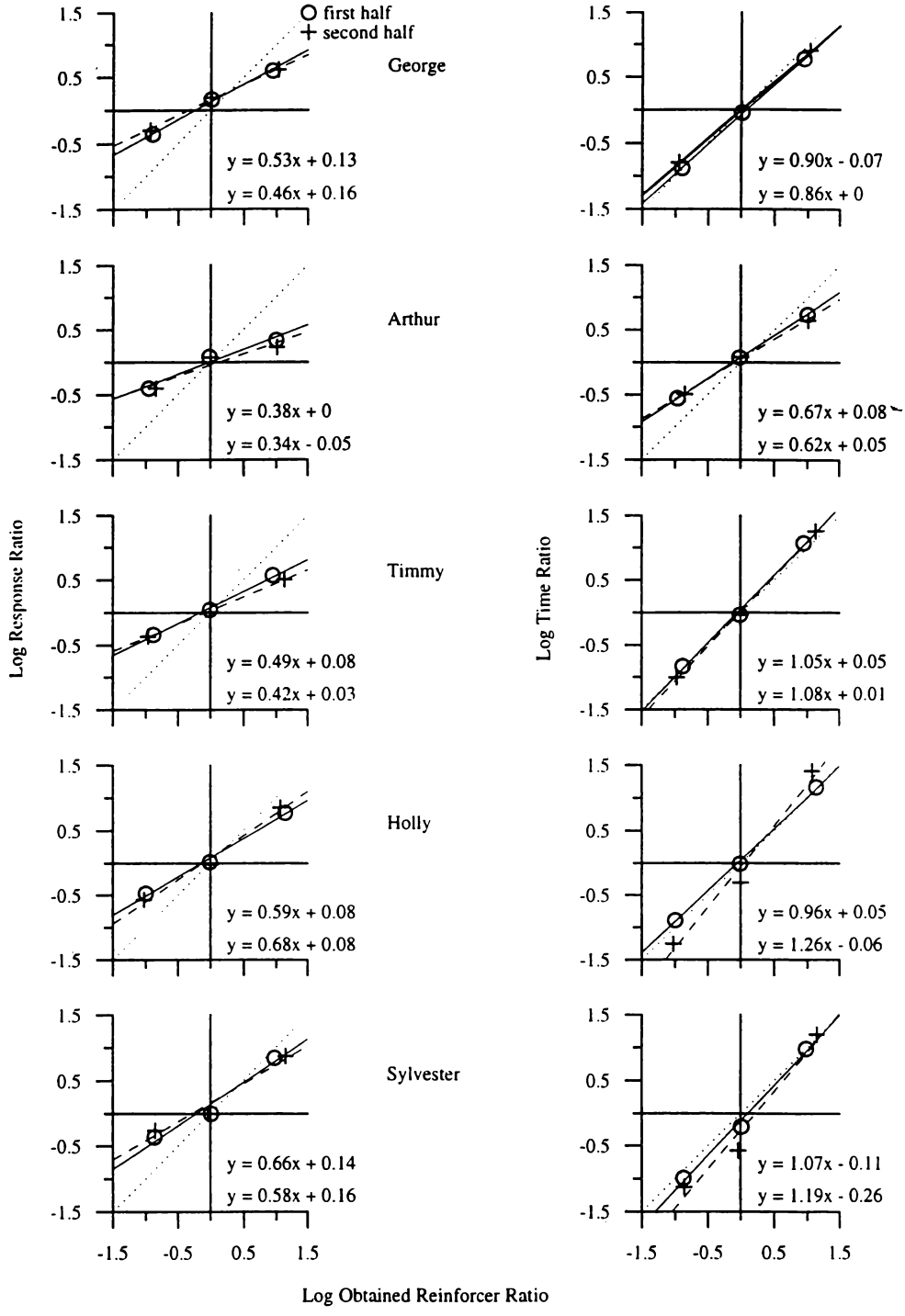


Figure 1.3. The logarithms of the response ratios from Conditions 2, 3 and 4 plotted for each half of the session.

calculated using the data from the second half of the session. The slope ($a$) and intercept (log $c$) of each of these lines, the percentage of variance accounted for by each of the lines (%VAC), and the standard errors of the estimates (SE) are presented in Table 1.2. The values of $a$ estimated from the response measures of behaviour were lower in the second half of the session for all but 1 subject (the exception being Holly). The bias measures obtained from the response-allocation measures for the first half of the session were smaller than, or equal to, the second-half response bias measures for all but 1 subject (Timmy). There were no consistent differences between either the slopes or intercepts of the matching lines describing the first and second half of the sessions in terms of time-allocation. The %VAC measures for response- and time-allocation during the first half of the session were greater than, or equal to, those obtained from the second half of the session for all but 1 subject (Timmy).

The left panel of Figure 1.4 shows the logarithms of the ratios of post-reinforcement-pause (PRP) times associated with each lever plotted against the logarithms of the obtained reinforcer-rate ratios. The right panel shows the logarithms of the ratios of the net-times spent responding on each lever (total-time allocated to each lever minus post-reinforcement-pause time) plotted against the logarithms of the obtained reinforcer-rate ratios. Since the PRP data were collected only during the last two conditions of the experiment, there are only two data points on each graph. To enable a direct comparison with total-time allocation, the centre panel shows the logarithms of the total-time-allocation ratios from the two conditions where PRP time was recorded, plotted against the logarithms of the obtained reinforcer ratios. The equations at the bottom of each graph describe the solid lines plotted through these points. The slopes ($a$) and intercepts (log $c$) of the lines describing the PRP and net-time data are presented in Table 1.2. Strict matching lines (dotted lines) have also been drawn for comparison.

The slopes of the lines describing the PRP times ($a$ values ranging from 0.68 to 1.12) were greater than or equal to those describing the net-times ($a$ values ranging from 0.68 to 0.96) for all but 1 subject (Holly). The slopes of the lines

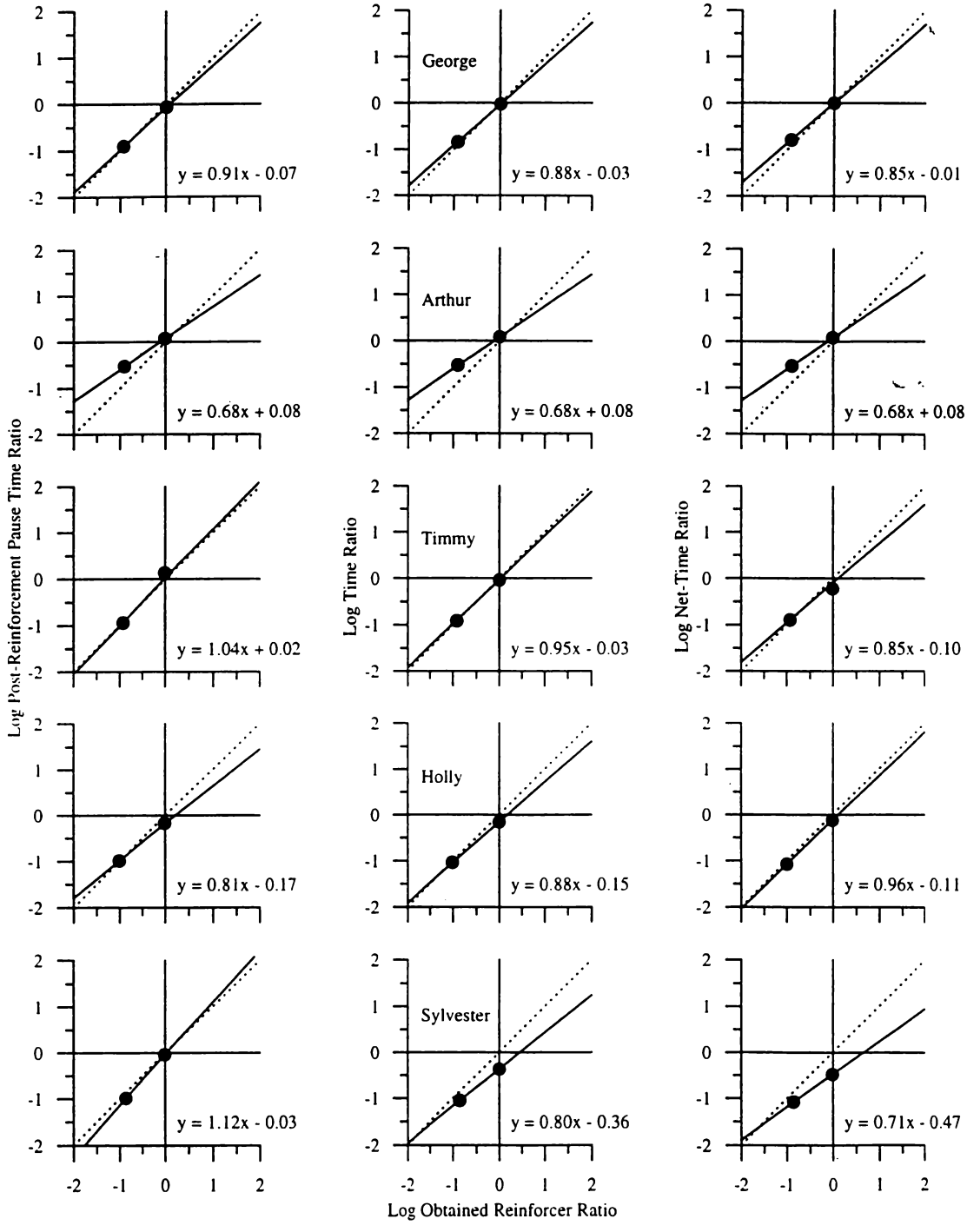


Figure 1.4. The logarithms of the post-reinforcement-pause time ratios, the logarithms of the time ratios, and the logarithms of the net-time-allocation ratios plotted as functions of the obtained reinforcer ratios from Conditions 3 and 4 only.

describing the PRP data deviated from 1.0 for all subjects. The data for 2 subjects (Timmy and Sylvester) exhibited overmatching (i.e., slopes greater than 1.0), while the remaining 3 subjects PRP data showed undermatching (i.e., slopes less than 1.0). Slopes of less than 1.0 were observed for all subjects' net-time data. When compared to the total time-allocation measures from the same two conditions, the slopes of the lines describing the PRP time data were greater than or equal to (and therefore, the lines describing the net-time data were less than or equal to) those describing the total-time-allocation for all but 1 subject (Holly). There were no systematic differences between total-time biases and either PRP or net-time biases.

Changeover Rates

Figure 1.5 shows, for each subject, the average number of changeovers made per minute during each condition plotted against the logarithms of the obtained reinforcer-rate ratios. For all subjects, the average number of changeovers made was greater during the equal VI schedule conditions (ranging from 1.66 to 5.87 per minute), and lower when the reinforcement schedules were unequal (ranging from 0.42 to 3.42 per minute), resulting in an inverted U-shaped function. For all but 1 subject (Timmy), there was a large difference in the rates of changeover during the two equal-schedule conditions. For all subjects, the rate of changing over was higher during the first equal VI schedule condition conducted.

Response Rates

The absolute response rates (number of responses made on each lever divided by total session time) during the first (filled circles) and second (unfilled circles) half of the session are plotted for each subject against the logarithms of the obtained reinforcer-rate ratios in Figure 1.6. The data from the left and right levers are shown separately (left and right panels respectively), and the data from the two equal-schedule conditions were averaged for each subject. Overall, the absolute rates of responding on each lever increased as the rate of reinforcement

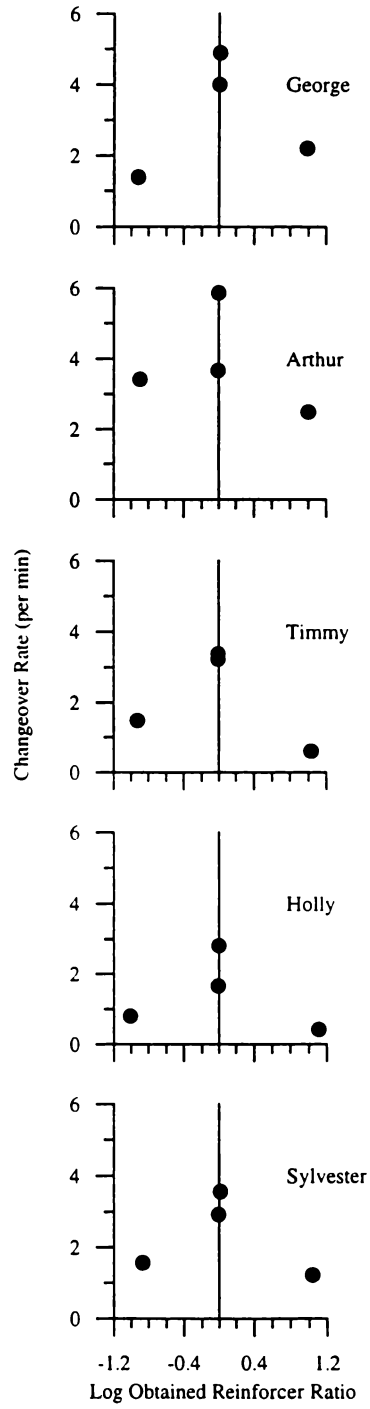


Figure 1.5. The rate of changeover for each possum during each of the conditions.

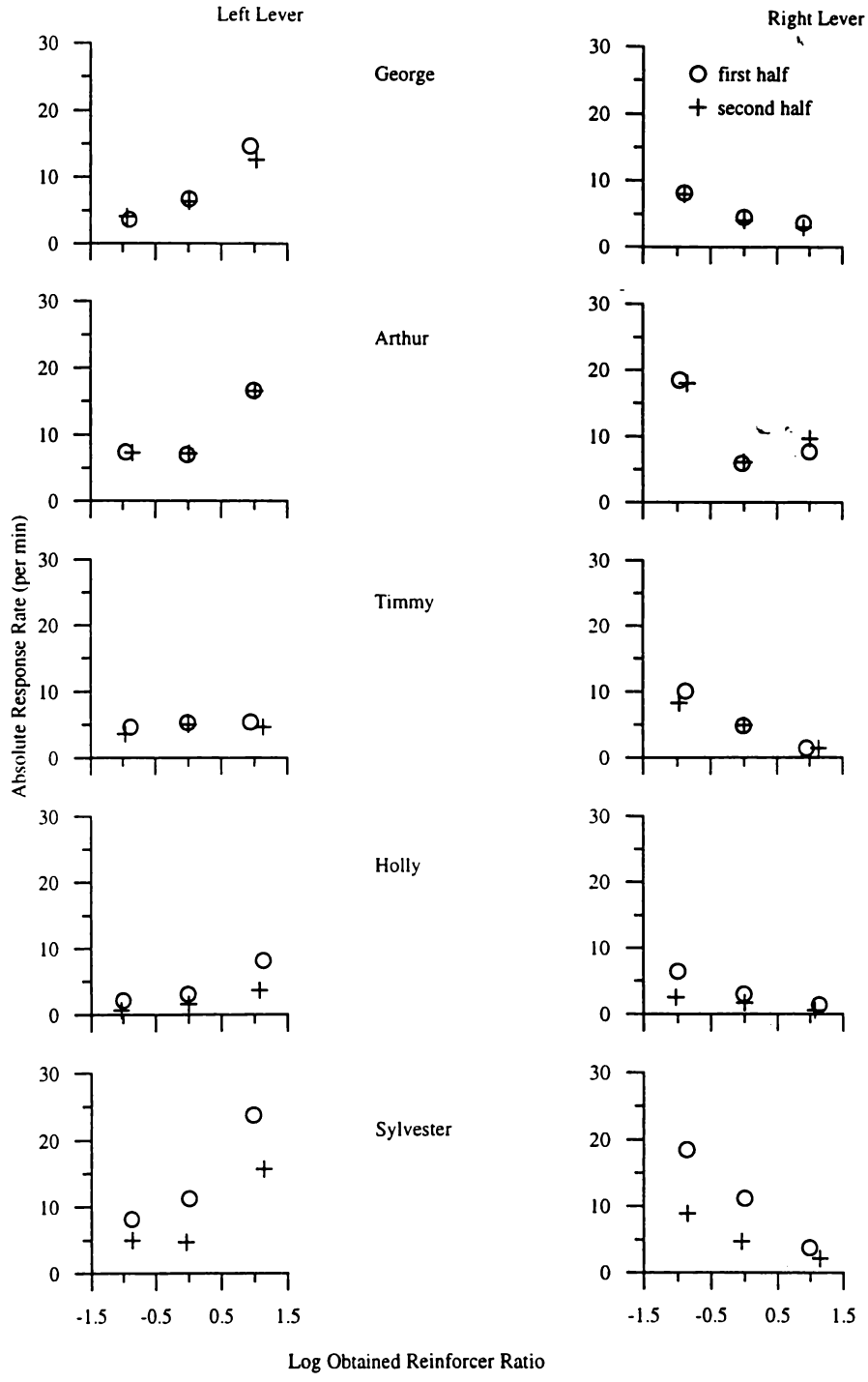


Figure 1.6. The absolute response rates on the left and right manipulanda plotted as functions of the logarithms of the obtained reinforcer ratios for the first and second halves of the sessions.

associated with that lever increased. The average numbers of responses made per minute ranged from approximately 0.5 on the lean alternative to approximately 26 on the rich alternative. For 3 subjects, the absolute rates of responding did not change during the session (i.e., responding was similar in each half of the session). However, for the remaining 2 subjects (Holly and Sylvester), the absolute response rates were always lower during the second half of the session in all conditions.

The local response rates (number of responses made on each lever divided by the time (in minutes) spent responding on that lever) are plotted against the logarithms of the programmed reinforcer-rate ratios for each subject in Figure 1.7. Again, the data are plotted separately for responding on the left lever (left panel) and the right lever (right panel), and the data from the first half (filled circles) and second half (unfilled circles) of the sessions have been separated. Data from the two equal-schedule conditions were again averaged for each subject. The local rates of responding tended to be higher on the lever that provided the lower rate of reinforcement, and decreased as the rate of reinforcement on that lever increased, with the average rate of responding ranging from about 2.6 responses per minute on the rich alternative to about 88 responses per minute on the lean alternative. As with the absolute rates of responding, there were no systematic differences between the local response rates observed during the first and second half of the session for 3 subjects. For the remaining 2 subjects (Holly and Sylvester) however, the local response rates also tended to be lower during the second half of the session.

Contingency-Discriminability Model

The logarithms of the ratios of responses and times allocated to each lever are again plotted against the logarithms of the obtained reinforcer-rate ratios for each possum in Figure 1.8 (as in Figure 1.1). In this figure however, the lines of best fit (solid lines) were calculated by non-linear estimation using Davison and Jenkins' (1985) C-D model. The actual equation used was the logarithmic form of Equation 0.7 (with $w$ set to zero). The estimates of the values of $d_r$ and

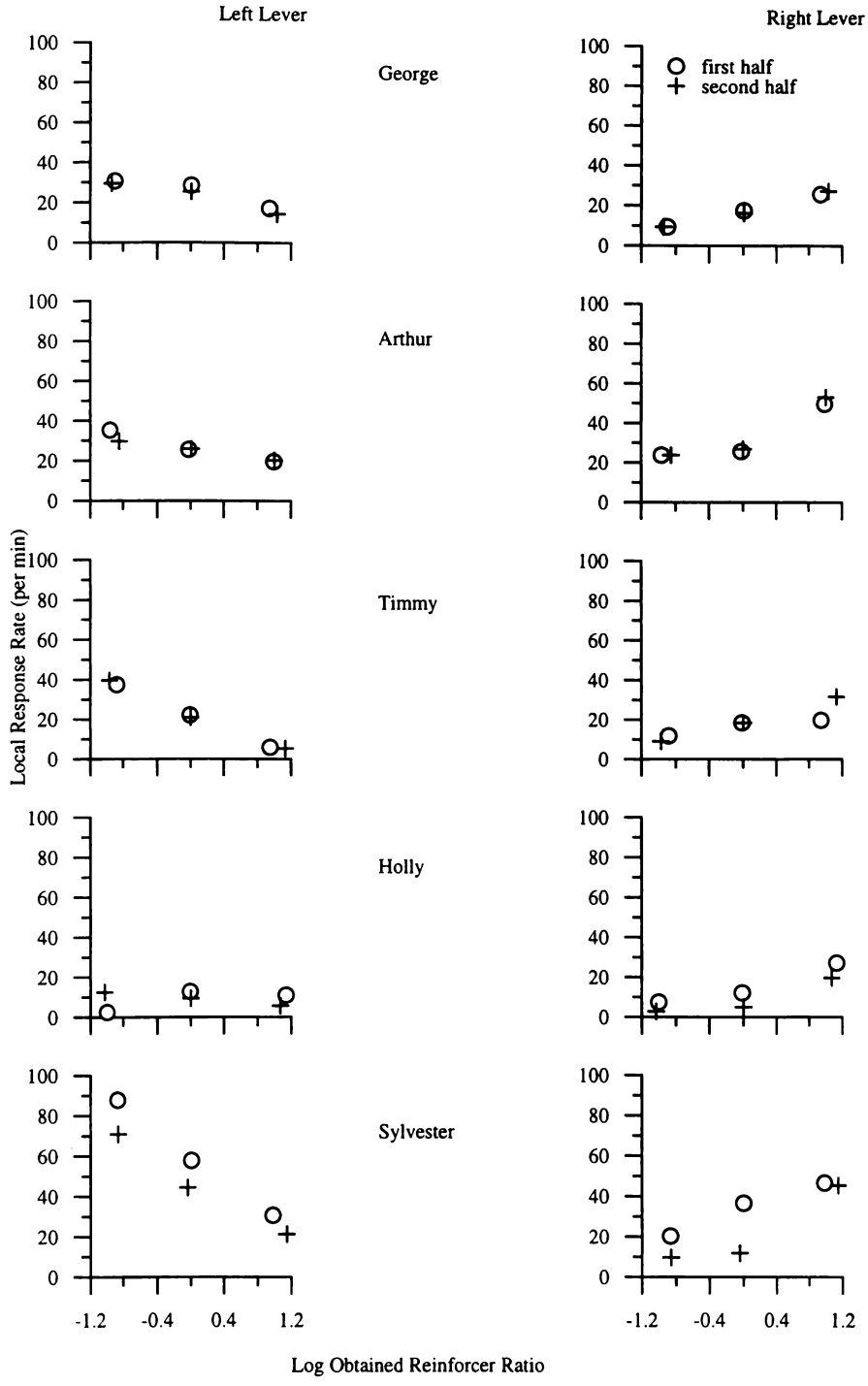


Figure 1.7. The local response rates on the left and right manipulanda plotted as functions of the logarithms of the obtained reinforcer ratios for the first and second halves of the sessions.

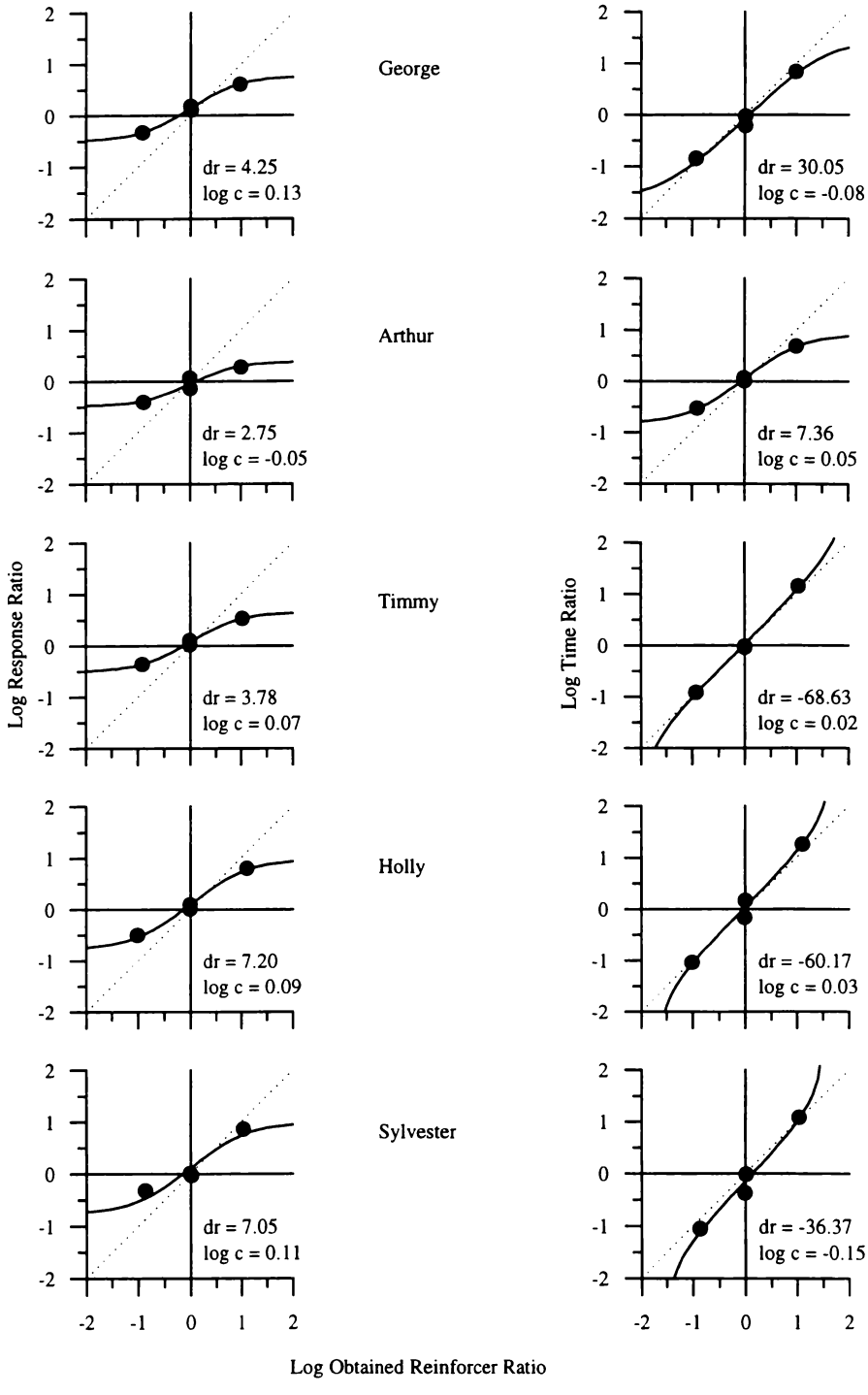


Figure 1.8. The logarithms of the response- and time- allocation ratios plotted as functions of the logarithms of the obtained reinforcer-rate ratios for each subject. The solid lines represent the lines of best fit according to the Contingency-Discriminability model.

log $c$ for each of these lines are presented at the bottom of each graph. The dotted line on each graph represents perfect discrimination, with $d_r$ equal to infinity and log $c$ equal to 0 (identical to a perfect matching line). Table 1.3 gives the values of $p_r$ ($p_r = d_r /(1 + d_r)$), $d_r$, log $c$ and the percentages of variance in the data accounted for (%VAC) by the regression lines for each subject.

The estimates of discriminability obtained from the response data were small for all subjects, ranging from 2.75 to 7.20. Larger estimates of $d_r$ were always associated with larger estimates of $a$ for response-allocation data. This is necessarily so, since all of the $a$ values were less than 1.0 in these data. The estimates of $d_r$ obtained from the time data show that the absolute value of $d_r$ was larger in those cases where $a$ was higher, with negative values associated with overmatching ($a > 1.0$). The %VAC by the lines describing both the response and time-allocation data were high for all subjects, with values ranging from 91.1% to 99.7%, indicating that the lines of best fit describe the data well. The average %VAC obtained from the C-D model and the GML were very similar for the response data (96.2% and 96.4% respectively), and identical for the time data (98.5%). The bias measures calculated from the response and time-allocation data using the C-D model were similar to those calculated using the GML for all but 1 subject (Timmy), and in all cases they were in the same direction.

Figure 1.9 shows the logarithms of the ratios of responses made within (left panel) and after (right panel) the COD plotted against the logarithms of the reinforcer-rate ratios (as in Figure 1.2). The dotted line on each graph represents perfect discrimination. The solid lines plotted through the points represent the lines of best fit calculated from the C-D model. The estimates of the values of $d_r$ and log $c$ from these lines are presented on each graph. The values of $p_r$ ($d_r /(1 + d_r)$), $d_r$, log $c$, and the percentages of variance in the data accounted for by the lines (%VAC) are presented in Table 1.3.

The estimates of $d_r$ calculated for the within-COD data were small for all subjects, ranging from 0.74 to 1.57. The estimates of $d_r$ were greater when the estimates of $a$ obtained from the GML analysis were closer to 1.0. For all subjects, despite finding some negative $d_r$ values, the absolute values of the

Table 1.3
The parameters resulting from the fit of the C-D model (Equation 0.7, with $w$ set to 0) to the response- and time-allocation data (Figure 1.8) and the within and post COD data (Figure 1.9).

| Possum | $p_r$ | $d_r$ | log $c$ | %VAC | $p_r$ | $d_r$ | log $c$ | %VAC |
|---|---|---|---|---|---|---|---|---|
| | | | Responses | | | | Time | |
| George | 0.81 | 4.25 | 0.13 | 99.30 | 0.97 | 30.05 | -0.08 | 97.99 |
| Arthur | 0.73 | 2.75 | -0.05 | 91.10 | 0.88 | 7.36 | 0.05 | 99.57 |
| Timmy | 0.79 | 3.78 | 0.07 | 99.22 | 1.01 | -68.63 | 0.02 | 99.67 |
| Holly | 0.88 | 7.20 | 0.09 | 98.88 | 1.02 | -60.17 | 0.03 | 98.04 |
| Sylvester | 0.88 | 7.05 | 0.11 | 92.27 | 1.03 | -36.37 | -0.15 | 97.40 |
| MEAN | 0.82 | 5.01 | 0.07 | 96.15 | 0.98 | -25.55 | -0.03 | 98.53 |
| | | | Within COD | | | | Post COD | |
| George | 0.56 | 1.30 | 0.44 | 61.24 | 0.93 | 12.41 | -0.09 | 98.80 |
| Arthur | 0.53 | 1.14 | -0.12 | 6.94 | 0.81 | 4.22 | -0.02 | 93.45 |
| Timmy | 0.43 | 0.74 | -0.03 | 71.27 | 0.94 | 15.56 | 0.07 | 98.52 |
| Holly | 0.61 | 1.57 | 0.18 | 29.54 | 0.95 | 17.26 | -0.01 | 98.54 |
| Sylvester | 0.52 | 1.10 | 0.28 | 3.07 | 1.00 | -220.94 | -0.09 | 98.53 |
| MEAN | 0.53 | 1.17 | 0.15 | 34.41 | 0.93 | -34.30 | -0.03 | 97.57 |

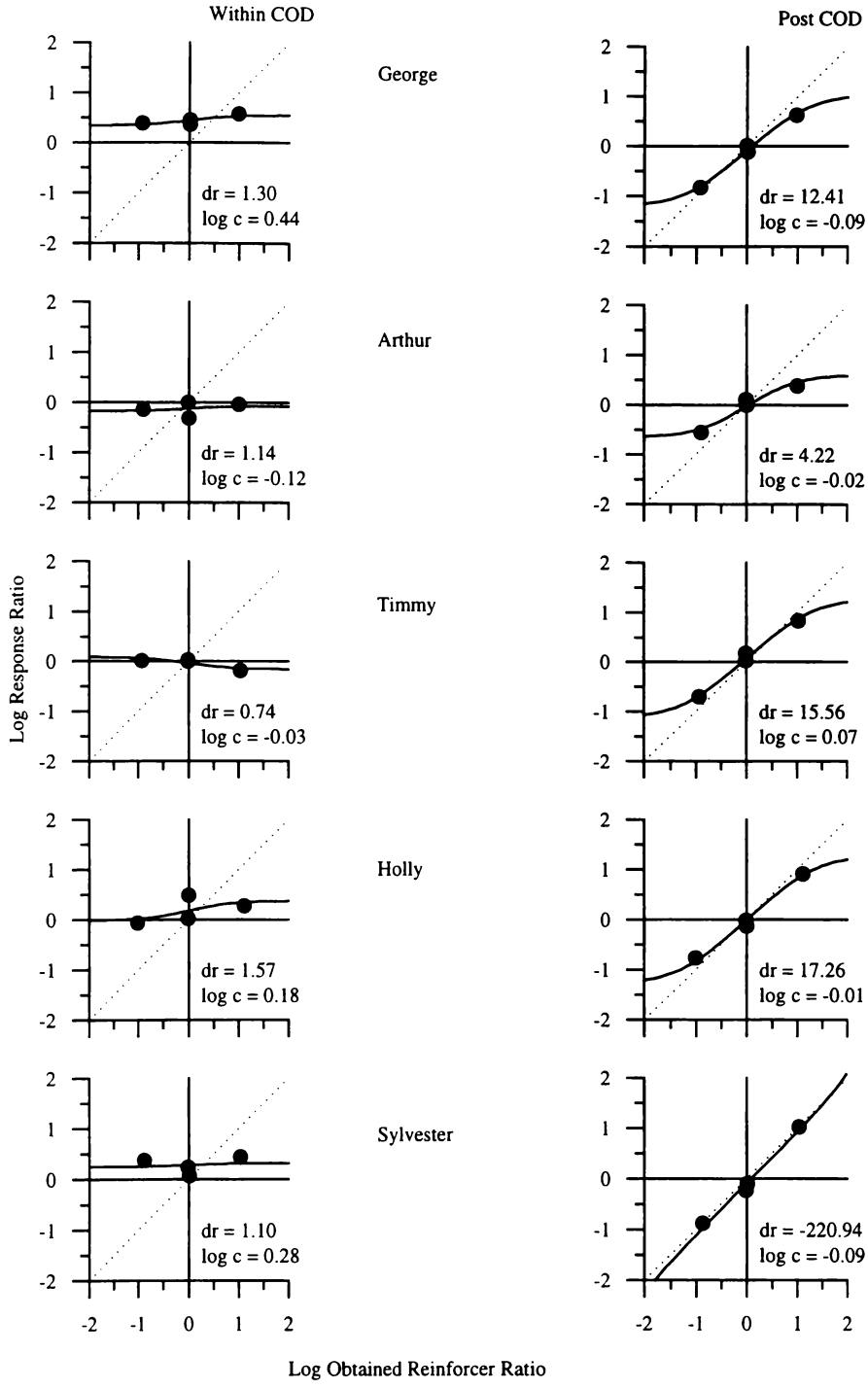


Figure 1.9. The logarithms of the ratio of responses made within and after the changeover delay plotted against the logarithm of the obtained reinforcer ratio for each subject. Solid lines represent lines of best fit obtained using the C-D analysis.

estimates were larger for responding which occurred after the COD than for responding that occurred within the COD. The large negative estimate of $d_r$ calculated for responding after the COD from Sylvester's data corresponds to a small amount of 'overmatching' (i.e., close to perfect discrimination). The estimates of log $c$ obtained from responding which occurred both within and after the COD were very similar to those obtained using the GML, and were all in the same direction. For all but 1 subject (Timmy), the amount of inherent bias (log $c$) was greater for responding which occurred within the COD than for responding which occurred after the COD, as was found using the GML.

The post-COD data were well described by the C-D model, with the %VAC by the lines describing the data ranging from 93% to 99%. The %VAC measures describing the within-COD data were quite small with values ranging from 3% to 72% (mean = 35%). These values are similar to those obtained using the GML, which were reduced due to the shallow slopes. This would have had the same effect on the %VAC values obtained using the C-D model.

## Discussion

### The Generalised Matching Law

The present experiment followed on from Muir's (1997) multiple concurrent-schedule research with possums, which showed that under such schedules possums' behaviour was extremely insensitive to changes in the reinforcer-rate ratio. Here possums' behaviour under simple concurrent schedules was studied to determine whether the large amount of undermatching found by Muir is characteristic of the possum, or was simply the result of the procedure used.

The present data show a closer approximation to matching for both response- (mean $a$ = 0.51) and time- (mean $a$ = 0.96) allocation measures than was previously found by Muir (1997) using multiple concurrent schedules of reinforcement (mean $a$ values of 0.25 and 0.56 for responses and times respectively). This suggests that the large degree of undermatching observed by

Muir (1997), using the same possums, was at least partially due to the use of multiple concurrent schedules of reinforcement. Observing a greater amount of undermatching when multiple concurrent schedules of reinforcement are used as opposed to simple concurrent schedules is not uncommon (e.g., Davison & Ferguson, 1978; McAdie et al., 1996). As previously mentioned, it is possible that the possums may have been unable to discriminate between the two components on the basis of the coloured lights that were used in Muir's study. There are currently no data to show whether or not possums can discriminate between red and green lights.

The mean time-sensitivity value found here was similar to that normally found with other species (0.89: Taylor & Davison, 1983), while the degree of undermatching observed in the response measures was greater than that typically observed with other species (about 0.8: Baum, 1979; Taylor & Davison, 1983). While the slopes of the lines describing response-allocation data are most commonly around 0.8 for hens (Temple et al., 1995), rats (Logue & de Villiers, 1978; Norman & McSweeney, 1978) and pigeons (Davison & Hunter, 1976; Hollard & Davison, 1971; Hunter & Davison, 1978), deviations from this have also been observed with species other than possums. For example, Dougherty and Lewis (1992), using horses, found that the slopes of the lines describing the response measures were close to 1.0 (*a* values ranged from 0.9 to 1.09). The slopes of the matching lines describing the response-allocation measures of both cows (Foster et al., 1996; Matthews & Temple, 1979) and goats (Foster et al., 1997) on concurrent VI VI schedules were much lower than 0.8 (and similar to those obtained here with possums), while the most common result for human subjects' response allocation appears to be overmatching (e.g., Bradshaw, Szabadi & Bevan, 1979; Ruddle, Bradshaw, Szabadi & Bevan, 1979; Schroeder & Holland, 1969). This suggests that, although it has been implied that matching is the 'ideal' result of concurrent-schedule research (e.g., Baum, 1976), the finding of matching is not universal, nor is the commonly reported finding of slopes approximating 0.8 for response allocation. While the response-allocation data in the present experiment showed a large amount of undermatching, the slopes were

still within the range reported in previous experiments with other species.

The finding that the time measures showed greater sensitivity to reinforcement than the response measures is consistent with past research (e.g., Davison & Hunter, 1976; Hollard & Davison, 1971; McAdie et al., 1996). Baum (1979) suggested that the difference between the sensitivities of response and time measures to changes in the reinforcer rates may be due to behaviours other than responding (such as chewing, drinking, grooming etc.). These behaviours are difficult to measure, and any time spent engaging in them is typically added onto the total time spent responding on the alternative to which the last response was allocated. Because more responses are generally made on the rich alternative, it is likely that more of these other behaviours will occur following a response on the rich alternative, and so a larger proportion of this time will be added to this alternative. This would have the effect of increasing the sensitivity of the time measures to the reinforcement-rate differences.

Possums have been observed to spend a large amount of time immediately after each reinforcer engaging in behaviours other than responding (Muir, 1997). This observation has also been made of cows (Foster et al., 1996; Matthews & Temple, 1979). After observing unusually low $a$ values for time measures with cows, Foster et al. (1996) suggested that this may be the result of asymmetrical pausing. If the amount of time spent pausing after each reinforcer on one alternative was greater than the pause time on the other alternative, this would have an effect on the time sensitivity values. Pausing for longer intervals after each reinforcer on the rich schedule would result in an overall increase in sensitivity to reinforcement for time measures (or overmatching). Greater pausing after each reinforcer on the lean alternative would result in an overall decrease in sensitivity, whereas equal amounts of time spent pausing after each reinforcer would result in a shift in overall time-allocation towards matching. Foster et al. (1996) suggested that the large amount of undermatching observed with time measures may have been due to more pausing on the lean alternative. They analysed the post-reinforcement-pause times on each alternative and found that approximately the same amount of time was spent pausing after the delivery of

each reinforcer. That is, post-reinforcement pausing was symmetrical, and the ratios of the post-reinforcement-pause times approximately matched the ratios of the reinforcement measures. When these pause times were removed from total session time, the net-time data gave lower sensitivity values, and therefore, asymmetrical pausing was not responsible for the low *a* values observed in the total-time measures for cows.

A similar analysis has been carried out with possums (Muir, 1997) and goats (Foster et al., 1997). Both studies found post-reinforcement pausing to be approximately symmetrical (Muir found evidence of asymmetrical pausing for 1 subject: $a = 1.13$), which resulted in greater *a* values for total-time allocation than net-time allocation. It is possible then, that symmetrical pausing was responsible for the higher sensitivity values found for the time measures when compared to response measures in the present experiment. Post-reinforcement pausing was measured during only two conditions in the present experiment. Analyses of the data from these two conditions showed that, for 3 subjects, the slopes of the lines describing post-reinforcement-pause times were slightly closer to 1.0 than those describing total-time-allocation. Therefore the sensitivity to the reinforcement-rate differences in terms of net-time-allocation (total-time minus post-reinforcement-pause time) was lower than that of total-time-allocation. This suggests that post-reinforcement pausing was at least partially responsible for the large difference between the response and time sensitivity measures. The difference between the estimates of net-time-allocation and response allocation from the two conditions where post-reinforcement pausing was measured was still large. This may be the result of pausing which does not occur immediately after reinforcement, and therefore was not measured here. Alternatively, this large difference may have occurred because response-allocation sensitivities were reduced by some other procedural factor.

During the present experiment, it was common for subjects to stop working before the end of the session. This could have affected time-allocation sensitivity, because if a large amount of the session time occurred after the possum stopped responding, this time would be added onto the total time for the

alternative to which the last response was made. If this was the case, time-allocation data from the first half of the session might be expected to be more representative of the possums' behaviour than total-time-allocation data. In general, the *a* values obtained from time data for the first half of the session were closer to 1.0 than the total-time-allocation *a* values. Therefore, it seems unlikely that the high sensitivity to reinforcement observed with time allocation was the result of a failure to complete the session (although first- and second-half data were only collected during three of the four conditions in the present experiment).

There are a number of factors which may have contributed to the large amount of undermatching found in the response measures in the present experiment. It is possible that the 2-s COD employed was not long enough to separate the schedules effectively. Several authors have suggested the importance of a sufficiently long COD (e.g., Baum, 1979; de Villiers, 1977; Shull & Pliskoff, 1967). As previously mentioned, Temple et al. (1995) studied the matching behaviour of hens across a range of COD values. They found that while sensitivity to reinforcement increased from the no COD condition to the 2 s COD condition, it remained stable beyond that point (up to a 15 s COD). This effect was observed for both time- and response-based measures. Similarly, Foster et al. (1996), with cows as subjects, found that increasing the COD from 3 to 5 s did not increase either the response or time sensitivities.

Since there appears to be a wide range of *a* values obtained with different species, it is possible that an average value of 0.5 is the best that can be expected for response matching by possums. However, only one COD was studied in the present experiment, and therefore there is little evidence to suggest that a 2-s COD is long enough to separate the schedules effectively with possums. For example, the results of Shull and Pliskoff (1967) suggest that rats require a COD of at least 7.5 s for matching to be obtained. It is possible that the behaviour of possums is more similar to that of rats than birds, and therefore increasing the COD beyond 2 s could result in behaviour which is closer to matching in terms of response allocation.

Baum (1982) claimed that the COD is discriminated by subjects (similar

to travel time or blackout) and can therefore be removed from calculations of matching behaviour. When responses which occurred within and after the COD in the present experiment were analysed separately it was found that sensitivity to the reinforcement-rate differences shown in the within-COD data was very low (mean $a = 0.04$). As a result, post-COD responding was more sensitive to changes in the reinforcer-rate ratio than total responding (mean $a = 0.77$ vs. 0.51). This result was also found by McAdie et al. (1996), Muir (1997) and Temple et al. (1995), and provides further support for Baum's claim that behaviour which occurs during this period of time should be removed before analysis. The mean difference between the post-COD and total-response allocation $a$ values (0.26) was similar in magnitude to that observed by Temple et al. (1995) at all COD values (but smaller than the difference of about 0.45 observed by McAdie et al., 1996). Therefore, since the sensitivity of total-response allocation was low in the present experiment, post-COD responding was also less sensitive than is normally observed. Whereas undermatching was still the most common result here, McAdie et al. (1996) and Temple et al. (1995) obtained overmatching in the post-COD data for most subjects. It is clear therefore, that the lower than normal sensitivity of response allocation to changes in the reinforcer-rate ratio found here was not simply the result of insensitive responding during the COD.

While responding is generally controlled by reinforcer-rate differences, inherent biases (e.g., position or colour preferences) can also affect responding on concurrent schedules. Overall, very little inherent bias was observed in the present experiment, although more bias was generally observed within the COD than after it. This result was also observed by Muir (1997) but is not consistent with simple concurrent research with hens (e.g., McAdie et al., 1996; Temple et al., 1995). Some subjects had been observed to respond differently to each of the levers during the present experiment. For example, George was observed responding with his paw to the right lever, while left lever responses mainly involved chin presses (which appeared faster than paw responses), with the occasional paw press. It has often been reported that responding occurs at a high rate immediately following a changeover, and quickly decreases to a low rate

following the end of the COD (e.g., Bourland & Miller, 1978; Dreyfus, Dorman, Fetterman & Stubbs, 1982; Silberberg & Fantino, 1970). If this is the case with possums, the different response topographies could place different limits on how fast responses can occur within the COD on each alternative. The time each event occurred was collected for each session during the third and fourth conditions of the present experiment, and therefore a detailed analysis of behaviour following a changeover was possible for these conditions.

Response rates were calculated for each 1-s interval following a changeover in the following manner: For each session, the number of responses made during each second following a changeover were calculated separately for each lever (up to 30 s). Also calculated was the number of times that a subject continued responding on each lever for the corresponding number of seconds (i.e., the total amount of time spent in each second following a changeover). For example, in one session a subject may have remained on an alternative for at least 5 s on 20 occasions, and for at least 30 s on five occasions (and therefore spent

20 s of the session time in the 5$^{th}$ second following changeover, and 5 s in the 30$^{th}$ second following changeover). These data were summed over the last five sessions of each of Conditions 3 and 4. Response rates for each second were then calculated for each lever by dividing the number of responses during each second by the amount of time spent in that second. A similar pattern of responding was observed for all subjects, and two examples of these data are plotted in Figure 1.10 for each second (up to 30 s) following a changeover. The top graph shows the data obtained from George during Condition 4 (concurrent VI 40-s VI 40-s schedules), while the bottom graph shows the data obtained from Arthur during Condition 3 (concurrent VI 22.5-s VI 180-s schedules). The pluses on each of these graphs represent responses made on the left lever, while unfilled circles represent responses made on the right lever.

These graphs clearly show that responding occurred at a much higher rate during the 2-s COD than at any other time following a changeover (this pattern of responding was found for all subjects and conditions), as is the case with other species (data are presented for only the first 30 s following a changeover,

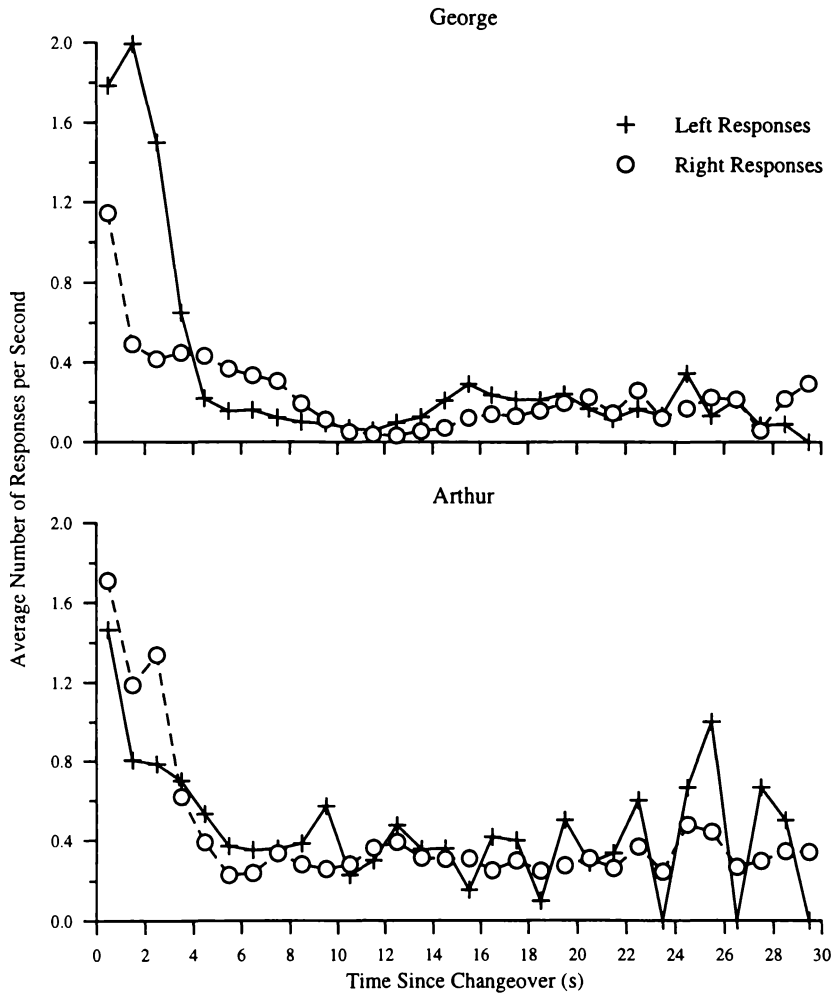


Figure 1.10. The average number of responses during each second following a changeover.

however, very little responding occurred after this period). It can also be seen that, for both of these subjects, responding occurred at a higher rate on one alternative (the left lever for George, where chin responses were observed, and the right lever for Arthur). This is probably due to the different response topographies observed, and results in large biases during the COD. For example, if chin responses (on the left lever) are able to be completed faster than paw responses (on the right lever), and responding always occurs at the maximum rate during the COD, a greater number of responses will always be made on the left lever. Because more left lever responses would occur during the COD at all reinforcer-rate ratios, this would result in a within-COD bias towards the left lever. Because post-COD responding occurred at a much lower rate than within-COD responding, the different minimum amounts of time required by the different response topographies could be expected to have less of an effect on post-COD behaviour. Therefore, when no experimentally introduced biasers are present, as in the present experiment, the rates of responding on the two levers should be affected mainly by the schedules of reinforcement. This would be expected to result in small post-COD biases, similar to those observed in the present experiment.

The data obtained from Timmy (although not presented here) are also consistent with the idea that the different response topographies are responsible for the large within-COD biases observed. In Timmy's case, response topographies on the two alternatives appeared very similar, and very little within-COD bias was observed ($\log c = -0.03$). The large amounts of bias observed with other possums within the COD here would not be expected with hens pecking keys if response topography is responsible, because it seems unlikely that the topography of a key-peck response would have enough variations that some would require different amounts of time to complete. Sumpter (1996) studied hens' concurrent-schedule behaviour with different response types. When concurrent VI (key-peck) VI (door push) schedules were arranged, the within-COD biases obtained were of a similar size to those observed in the present experiment. Analyses of these data showed that a door push took about 1.5 times

longer than a key peck response. Therefore, the finding of similar within-COD biases suggests a reasonably large difference in the times required for the different response topographies in the present experiment.

The use of arithmetic VI schedules may have contributed to the large amount of undermatching observed in the response measures here. Taylor and Davison (1983) reviewed the results of several concurrent VI VI experiments using either arithmetic or exponential schedules and found that sensitivity to reinforcement was greater when exponential schedules were used for both response (0.97 vs. 0.79) and time (0.96 vs. 0.89) measures. However, the amount of undermatching observed in the response measures here was still markedly greater than that normally observed when using arithmetic schedules of reinforcement, while the sensitivity values observed for time measures were more similar to those normally found with exponential than arithmetic schedules. Therefore, it is unlikely that the use of exponential instead of arithmetic schedules would have greatly reduced the amount of undermatching observed in the present experiment.

Alsop and Elliffe (1988) looked at sensitivity to reinforcement at different overall rates of reinforcement. They reported that as overall reinforcement rate increased, so too did sensitivity to reinforcement for both response and time measures. The overall reinforcement rates used by Alsop and Elliffe (1988) ranged from 0.22 to 10 reinforcers per minute, and the closest mean approximation to perfect matching obtained from their response-allocation data was $a = 0.72$ (with 10 reinforcers per minute available). In the present experiment, the overall rate of reinforcement was held constant across conditions, and only three reinforcers on average were available per minute. It is possible, therefore, that this low overall reinforcement rate was a contributor to the large amount of undermatching observed. Alsop and Elliffe (1988) obtained $a$ values of 0.61 and 0.66 with reinforcer rates of two and five reinforcers per minute, respectively. These are still larger than the $a$ values found for the response allocation data in the present experiment. Other experiments which have found a large amount of undermatching have not kept the reinforcer-rate constant (Foster

et al., 1997; Foster et al., 1996; Matthews & Temple, 1979). These experiments have generally arranged between one and three reinforcers per minute with mean *a* values for response allocation ranging from 0.39 to 0.47. Again, these are lower than those obtained by Alsop and Elliffe at similar reinforcer rates. While Alsop and Elliffe's (1988) results suggest that increasing the overall reinforcer rate may increase the sensitivity to reinforcement of possums' behaviour, other studies have obtained closer approximations to matching than Alsop and Elliffe with low overall reinforcement rates. For example, Temple et al. (1995) used reinforcer rates which varied between 0.83 and 2.5 reinforcers per minute and obtained a mean *a* value of 0.79 for response allocation with hens (using a 2-s COD). Dougherty and Lewis (1992) obtained *a* values ranging from 0.90 to 1.09 for response allocation with horses with overall rates of reinforcement ranging from 2.0 to 2.67 reinforcers per minute. These experiments suggest that the overall rate of reinforcement may not be as important for obtaining matching as suggested by Alsop and Elliffe (1988).

Changeover Rates

The rates of changing over between the schedules in the present experiment were highest when the schedules were equal (i.e., concurrent VI 40 VI 40) and decreased as the differences between the schedules increased. This result has previously been demonstrated in possums (Muir, 1997) and is a common finding with other species (Baum, 1974; Catania, 1963; Herrnstein, 1961; Sumpter et al., 1995). The rate of changing over in the present experiment was greater than is normally observed with other species. The average rate of change over across all subjects when the schedules were equal was 3.6 per minute. While similar rates of change over have been observed with rats (Baum, 1976; Shull & Pliskoff, 1967), lower rates have been observed with hens (about 2/min: McAdie et al., 1996), and pigeons (about 1.5/min: Miller, 1976). It is possible, then, that possums are more similar to rats than to birds in this respect. However, rate of changing over is also related to the length of the COD (Shull & Pliskoff, 1967; Silberberg & Fantino, 1970; Stubbs & Pliskoff, 1969; Temple et al., 1995). The

possibility that the COD in the present experiment was too short to produce the independence between the schedules required for matching may be responsible for the high changeover rates observed here.

Response Rates

It has been found that absolute response rates on an alternative tend to increase with increases in the rate of reinforcement provided on that alternative (Davison & Ferguson, 1978; Herrnstein, 1961), while local response rates tend to be inversely related to reinforcement rate (i.e., responding is 'faster' on the lean alternative; Baum, 1979). These results were also found in the present experiment, suggesting that the overall pattern of responding exhibited by possums is similar to that of other species. However the rates of responding observed with possums both in the present experiment and Muir's (1997) experiment were markedly lower than those typically obtained with other species (Baum, 1976; Bradshaw et al., 1979; Davison & Hunter, 1976; Herrnstein, 1961; Ruddle et al., 1979). It should be noted, however, that response rates are related to a number of factors including the rate and duration of reinforcement, the level of deprivation of the subject (Morse, 1966), and response topography (e.g., Davison & Ferguson, 1978). It is possible, therefore, that the decreased rates of responding found in the present experiment were due to a combination of these factors, rather than being inherent to the possum.

Generally, the level of deprivation is well controlled in concurrent-schedule research. About 80% of the free-feeding body weight is normally used with rats (e.g., Baum, 1976), hens (e.g., McAdie et al., 1996; Temple et al., 1995) and pigeons (e.g., Hollard & Davison, 1971; Hunter & Davison, 1978). This is reasonably easy to accomplish with daily weighing and supplementary feeding. Since possums are extremely difficult to handle, the deprivation level is more difficult to control. Consistent with what has been done with cows (Foster et al., 1996) and goats (Foster et al., 1997), the possums were weighed only fortnightly, and the amount of post feed was adjusted under any of the following situations. If the subject had been regularly losing weight, the post feed was increased. If the

subject had been regularly gaining weight, the post feed was decreased. Finally, if the amount of work during the experimental session had decreased, the post feed was reduced for that day. While this method is successful in maintaining a reasonably constant weight and at least a moderate level of deprivation, it does not measure exactly how deprived the subject is. Therefore no direct comparison can be made of the level of deprivation of the possums to that of other species.

The Contingency-Discriminability Model

Davison and Jenkins' (1985) C-D model (using the logarithmic form of Equation 0.7, with $w$ set to zero) described the present response-allocation data well. The %VAC by the regression lines was above 91% for all subjects. The C-D model and the GML were equally good at describing the data in the present experiment, each accounting for very similar amounts of the variance in the data. The measures of the discriminability of the response-reinforcer contingencies ($d_r$) calculated from the response-allocation data in the present experiment (range: 2.75-7.20) were lower than has been obtained in previous experiments. Davison and Jones (1995) reported $p$ values (confusability) ranging from 0.06 to 0.19 which, according to their definition of $p$ (the inverse of $d_r$), correspond to $d_r$ values ranging from 5.26 to 16.67, while Jones and Davison (1998) reported log $d_r$ values ranging from 0.48 to 1.03 ($d_r$ ranging from 3.02 to 10.72). In both of these experiments, a switching-key concurrent-schedule procedure was used with two different intensities of yellow light as the main key stimuli. While no mention was made of how different these two yellow lights were, it does not seem unreasonable to assume that the simple left-right discrimination required of the possums in the present experiment would be 'easier' (i.e., the response-reinforcer discriminability should be higher), yet the values of $d_r$ obtained here were slightly lower than those obtained with pigeons in the above experiments.

In both of the papers mentioned above, Equation 0.4 was presented. Davison and Jones (1995) stated that $p$ in that equation is equal to the inverse of $d_r$ (which is $1/d_r$). However, when $1/d_r$ is substituted for $p$ in Equation 0.4, the resulting equation does not reduce to Equation 0.3 (the original C-D equation).

Davison and Jones (1995) also stated that $p$ ranges from 0 (when discriminability is perfect) to 0.5 (when the subject is unable to discriminate). However, this is not true when $p = 1/ d_r$. When discriminability is perfect, $d_r = \infty$, and $p = 1/\infty$, or 0, which is consistent with the stated values of $p$. On the other hand, when the subject is unable to discriminate, $d_r = 1$, and $p = 1/1$, or 1. Therefore, $p$ cannot equal $1/ d_r$ in Equation 0.4, and the values of $d_r$ given above for Davison and Jones' study are incorrect.

Jones and Davison (1998) again presented Equation 0.4, this time stating that $p = d_r /(1 + d_r)$. Again, however, substituting $d_r /(1 + d_r)$ into Equation 0.4 does not give Equation 0.3. In this case, when discriminability is perfect,

$p = \infty/(1 + \infty)$, or 1 (not 0 as originally stated), while when the subject is unable to discriminate, $p = 1/(1 + 1)$, or 0.5. Jones and Davison did not use this equation for analyses of their data however, so the values of $d_r$ given for their experiment are correct. The correct definition of $p$ in this case is actually $1/(d_r + 1)$. When this is substituted for $p$ in Equation 0.4, Equation 0.3 is obtained. In addition, when discriminability is perfect, $p = 1/(\infty + 1)$, or 0, and when the subject is unable to discriminate, $p = 1/(1 + 1)$ or 0.5. These values are consistent with those originally stated by both Davison and Jones (1995) and Jones and Davison (1998). The correct values of $d_r$ obtained by Davison and Jones (1995), then, ranged from 4.26 to 15.67. These values are similar to those originally reported, and again, are higher than those obtained in the present experiment.

Alsop and Davison (1991) studied concurrent-schedule behaviour using a switching-key procedure with seven different pairs of stimuli. In all cases the main key stimulus was a white light, but the intensity was varied across conditions from no difference between the stimuli signalling the two schedules up to a large difference. While no measure was taken of the differences in intensity of the two lights, as the relative difference increased so did the values of log $d_r$ reported. With the most disparate pair, the obtained log $d_r$ values ranged from 0.93 to 4.14 ($d_r$ ranged from 8.51 to 13,803). Again these values were much higher than those observed in the present experiment. The middle pair of stimuli (with $d_r$ ranging

from 2.45 to 5.25) gave the most similar values of $d_r$ to those in the present experiment, again suggesting that, according to the C-D model, possums found the response-reinforcer contingencies unusually difficult to discriminate in the present experiment. The finding of lower than normal values of $d_r$ in the present experiment is consistent with the *a* values from the GML analysis here, in that the possums' response-allocation measures were found to be less sensitive to changes in the reinforcer-rate ratios than those of most other species. Why this discrimination might be more difficult for some species than others is not clear.

The time-allocation data were also well described by the C-D model, with the %VAC by the regression lines above 97% for all subjects. Again, the data were equally well described by the C-D model and the GML. However, in three out of five cases (where overmatching was observed using the GML) the obtained value of $d_r$ was negative. According to Davison and Jenkins (1985), the value of $d_r$ can range only from 1.0 (no discriminability) to infinity (perfect discriminability). One assumption of the C-D model is that, when discriminability is perfect, strict matching will be observed, while in any case where discrimination is less than perfect, the data will show undermatching in a GML analysis (Davison & Jenkins, 1985). Based on this assumption, overmatching (which gives negative $d_r$ values) should never be observed, as this would imply 'better' than perfect discrimination. However, overmatching is not uncommon in time-allocation measures (e.g., Lobb & Davison, 1975; Norman & McSweeney, 1978; Silberberg & Fantino, 1970; Stubbs & Pliskoff, 1969). As previously mentioned, it has been suggested that when *a* values slightly greater than 1.0 are obtained, they are actually the result of statistical error (Baum, 1979; Davison & Jenkins, 1985) with the 'true' value being 1.0. In other words, if the *a* value obtained was not 'significantly' greater than 1.0, overmatching was not really found, and discriminability was actually perfect.

Baum (1979) suggested that values of *a* ranging from 0.9 to 1.11 were equivalent to (or not significantly different from) 1.0. While in some cases it may true that an *a* value of 1.09 is not significantly different from 1.0, it would be equally correct to say that it is not significantly different from 1.10. Therefore,

although it may be convenient to say that the true value is really 1.0, such a statement does not seem entirely justified. A more practical solution may be to view the occurrence of overmatching as the result of less than perfect discriminability, and therefore as being similar to undermatching since, in both cases, the ratio of responses made to the two alternatives has deviated from the ratio of reinforcers received. The value of $d_r$ is negative when overmatching occurs, being approximately negative infinity when $a$ is only slightly greater than 1.0, with smaller negative values as $a$ moves away from 1.0 (indicating negative discriminability). A negative measure of discriminability makes no sense (Baum, Schwendiman & Bell, 1999), therefore it may be appropriate to describe discriminability with the absolute value of $d_r$. This would result in overmatching being viewed as less than perfect discrimination rather than a statistical error, which may be preferable especially given how common the finding is.

Davison and McCarthy (1994) introduced $p_r$, a measure of relative discriminability, into the C-D equation ($p_r = d_r /(1+ d_r)$). A $p_r$ value of 0.5 is equivalent to a $d_r$ value of 1.0 (no discrimination), while a $p_r$ value of 1.0 is equivalent to a $d_r$ value of infinity (perfect discrimination). The parameter $p_r$ was introduced simply to make fitting the equation easier (Davison & McCarthy, 1994). Whereas values of $d_r$ become negative in the case of overmatching according to the GML, $p_r$ simply becomes greater than 1.0 (implying better than perfect discrimination, which, again, makes no sense). In this respect $p_r$ in the

C-D model is similar to $a$ in the GML. It is possible then, that $p_r$ values slightly greater than 1.0 are also the result of statistical error, and an argument could again be made that, in such cases, discriminability was actually perfect. For example, the $p_r$ value of 1.01 calculated from the time-allocation data of 1 subject in the present experiment could be said to represent perfect discrimination of the response-reinforcer contingencies for this subject, because it is unlikely that a slope of 1.01 is significantly greater than 1.0. However, the only apparent justification for making such an assumption is the fact that without doing so the C-D model would surely be seen to fail.

Analyses of time-allocation data with the C-D model have been reported

in only one other study (Alsop & Davison, 1991). The obtained values of $d_r$ ranged from 4.57 to 31.62, and were similar to the values obtained by 2 subjects in the present experiment. The values of $d_r$ for time measures reported by Alsop and Davison (1991) were lower than those reported for their response measures. This is not consistent with most GML analyses where time-allocation $a$ values are generally closer to 1.0 (strict matching) than response allocation $a$ values. Alsop and Davison suggested that this may have been the result of the procedure used, and therefore the results may not be directly comparable with the time-allocation data obtained in other experiments. In Alsop and Davison's study, the schedule presented on the main key (in a switching-key concurrent-schedule procedure) was randomly selected following the delivery of each reinforcer. This could have had an effect on the subjects' behaviour. If any post-reinforcement pausing occurs with pigeons and is symmetrical (i.e., if subjects pause for the same amount of time after each reinforcer, as appears to be the case with some other species (Foster et al., 1996, Foster et al., 1997)), the random alternation of the schedules following each reinforcer could result in the equal distribution of this pausing to each alternative. This would happen because in half of the cases, after a reinforcer has been obtained on the rich alternative, the schedule would be automatically changed to the lean schedule (and vice-versa). Therefore, the number of pauses which occur while the lean schedule is in effect, and therefore the total amount of time allocated to that schedule, would increase, while the number of pauses occurring while the rich schedule is in effect would decrease. In this case, total-time allocation across the two schedules would become more similar, and overall, time allocation would appear less sensitive to changes in the reinforcer ratio.

Although this is a reasonable explanation as to why time allocation may be less sensitive to changes in the reinforcer-rate ratio than response allocation in this case, the finding of less sensitive response allocation is not universal. For example, Temple et al. (1995) found no systematic differences between the sensitivity to reinforcement of response and time allocation, while Heyman (1979) and Davison (1991) both found that the slopes of the matching lines describing response allocation were greater than those describing time allocation. There

were no obvious procedural differences between these two experiments and others where time allocation has been found to be the more sensitive measure of behaviour. This suggests that time allocation should not necessarily be expected to be more sensitive to changes in the reinforcer-rate ratio than response allocation. Any differences observed may simply be the result of differential pausing during the session, although the reasons for these differences are unclear.

Jones and Davison (1998) suggested that subjects will always match the 'perceived' reinforcer-rate ratio. Therefore, when discrimination is perfect, the perceived and actual reinforcer-rate ratios must be the same. The finding of different values of $d_r$ for time- and response-allocation measures of behaviour does not seem to support this idea. Since most analyses using the C-D model have not analysed time-allocation data (and time allocation often shows overmatching), Jones and Davison were probably referring to response allocation when they made this statement.

Davison and Jones (1995) studied concurrent VI VI schedule behaviour over a wide range of reinforcer-rate ratios in an attempt to determine whether the GML or the C-D model was more appropriate for the study of choice. As previously pointed out, they argued that when data are collected over the usual range of reinforcer-rate ratios (0.1:1.0 to 10:1.0; Davison & Jenkins, 1985), the two models differ little in their descriptions of behaviour. However, since the C-D model predicts an s-shaped function, while the GML predicts a straight line, if the C-D model is more appropriate, behaviour at extreme reinforcer-rate ratios should deviate more from perfect matching than behaviour at reinforcer-rate ratios within the range normally used. Davison and Jones (1995) presented pigeons with nine concurrent VI VI schedule pairs. Five of those pairs had reinforcer-rate ratios within the range normally used (providing the central data), while the remaining four pairs gave extreme reinforcer-rate ratios. Using the GML, Davison and Jones analysed the response-allocation data from all nine schedule pairs, and also the central data alone. They found that the estimates of $a$ were greater in all cases when only the central data were analysed. In other words, behaviour at the extreme reinforcer-rate ratios was less sensitive to reinforcement-

rate differences. They then analysed the data from all nine schedule pairs using the C-D model. Both models provided good fits to the data from all schedule pairs with little difference between the %VAC measures provided by the two equations, although Davison and Jones did suggest that the C-D model appeared preferable because it accounted for the deviations from the straight line predicted by the GML. Based on the above analyses, they suggested that the C-D model was more appropriate for the analysis of choice behaviour. However, as previously pointed out, they failed to test whether the response measures at extreme reinforcer-rate ratios were well predicted by the C-D model when only the central data were analysed. They stated that this analysis was not done because the parameters of the C-D model are determined mainly by the extreme data. However, if the C-D model predicts that behaviour is going to become less extreme as the reinforcer-rate ratio becomes more extreme, any analyses using the central data should not be expected to differ much from those using all of the data.

Using Davison and Jones' data, both the GML and the C-D model were fitted to the five central data points, all nine data points and, out of interest, the four extreme data points. Figure 1.11 shows the difference between the predicted and the obtained response ratios (i.e., the residuals, or the logarithms of the response ratios predicted by the GML minus the logarithms of the obtained response ratios) plotted against the logarithms of the obtained reinforcer-rate ratios for all data points. In the left panel, all data were used in obtaining the $a$ and log $c$ values for the predictions, in the central panel, only the five central data points were used, while in the right panel only the four extreme data points were used. The same analyses carried out with the C-D model are presented in Figure 1.12. The solid line on each of the graphs in these figures represents the point where the predicted and obtained values are equal (i.e., residuals = 0). Therefore, the closer the data points are to this line, the better the model is at predicting the subjects' actual behaviour. It can be seen from these figures that, when all of the data were used and when only the extreme data were used, both models were able to predict the subjects' behaviour well. There was, in fact, little difference between how well the two models predicted behaviour. When the GML was fitted

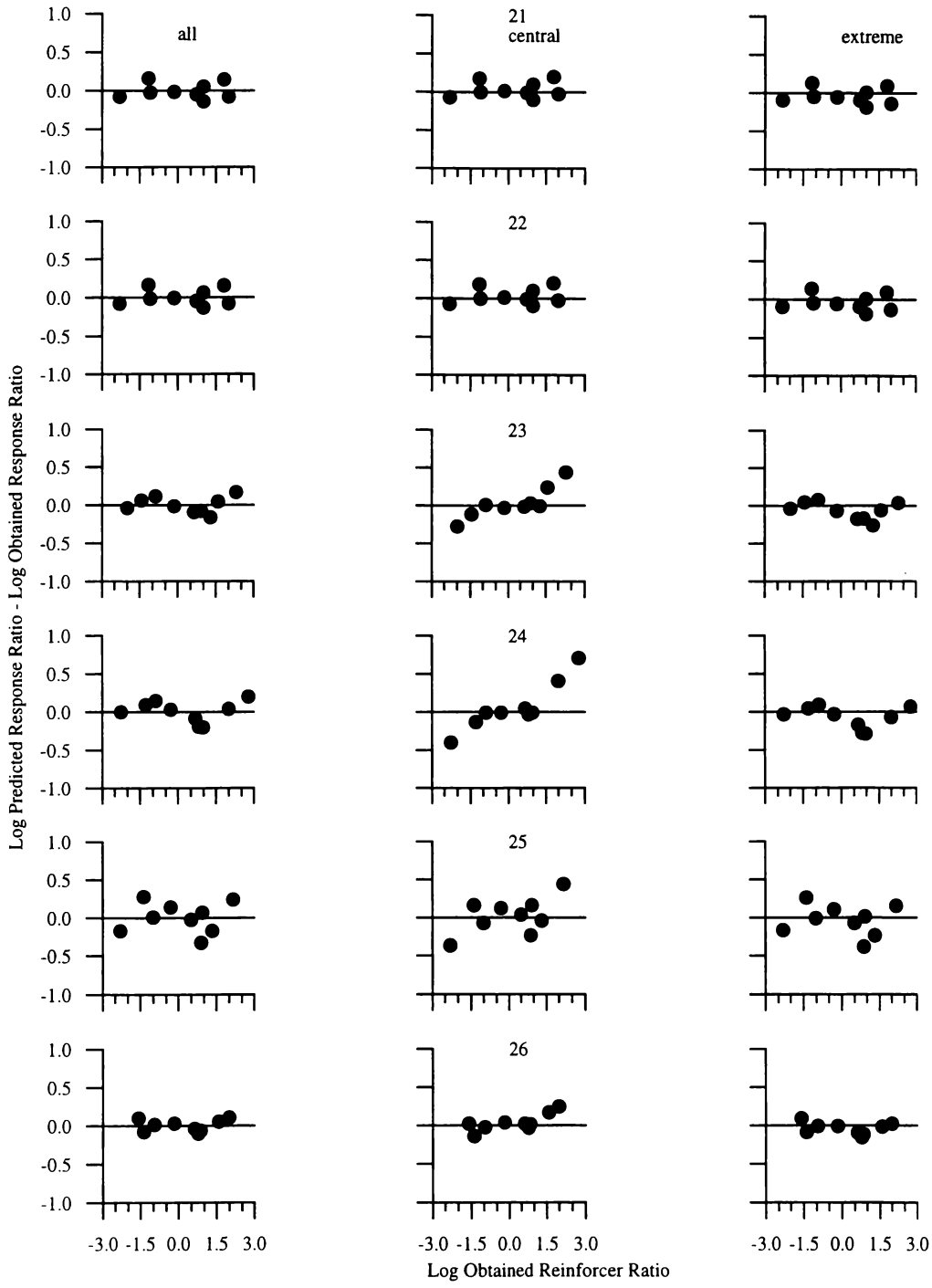


Figure 1.11. The difference between the predicted and obtained logarithms of the response ratios plotted against the logarithms of the obtained reinforcer ratio for the data collected by Davison and Jones (1995). The data were analysed using the GML.

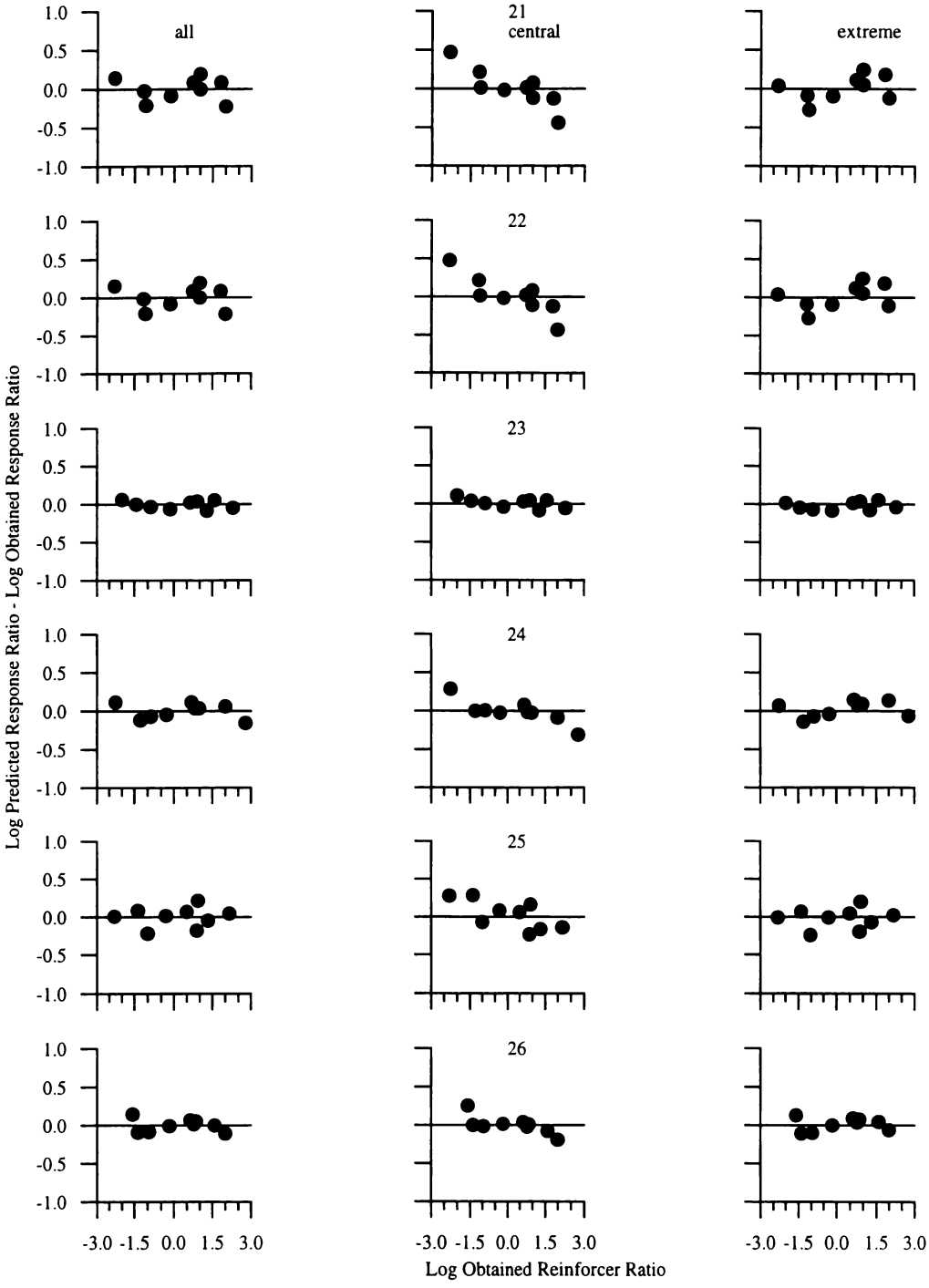


Figure 1.12. The difference between the predicted and obtained logarithms of the response ratios plotted against the logarithms of the obtained reinforcer ratio for the data collected by Davison and Jones (1995). The data were analysed using the C-D model.

to the central data, it can be seen that the resulting equation did not predict behaviour at extreme reinforcer-rate ratios well. At extreme reinforcer-rate ratios, the observed response-allocation ratios were less extreme than predicted. When the same analysis was conducted using the C-D model, the observed response-allocation ratios were more extreme than predicted. Overall, neither model appeared better than the other at predicting behaviour in any of the above cases, although both models predict more accurately when a wider range of reinforcer-rate ratios are used.

The results of the present experiment indicate that possums respond similarly to other species on concurrent schedules of reinforcement, and that their behaviour is well described by the generalised matching law. The C-D model appears to describe the response data from the present experiment about as well as the GML (the %VAC by the two models was very similar). However, the C-D model appears to cope less well with time-allocation data and post-COD data.

Whether or not these conclusions hold for other COD values is the subject of the next experiment. As previously mentioned, the possums' behaviour under these concurrent schedules was somewhat insensitive to changes in the reinforcer-rate ratio. It is possible that changing the COD length will increase this sensitivity.

# EXPERIMENT 2

In Experiment 1, a range of concurrent VI VI schedules of reinforcement were presented to possums, each with a 2-s COD. Analyses of these data using the GML showed a large amount of undermatching for all subjects' response-allocation data. The length of the COD was identified as one of the possible contributors. Temple et al. (1995) found that increasing the length of the COD beyond 2 s did not improve the matching behaviour of hens, suggesting that the presence of a COD may be more important than its length. However, Shull and Pliskoff's (1967) results suggested that a COD of 7.5 s is required for matching to be obtained with rats. Therefore, it is possible that a 2-s COD is not sufficiently long for matching to be obtained with possums.

Several potential problems with the way the C-D model copes with post-COD data (particularly when the data show overmatching) were discussed in Experiment 1. Two possible effects of introducing a COD were identified: 1. Increasing discriminability; or 2. Punishing change-over behaviour. An increase in discriminability would be evidenced by an increase in $d_r$ with increases in the length of the COD (i.e., the value of $d_r$ should become closer to infinity with each increase in COD length), whereas punishment of changeover behaviour would be evidenced by increases in $w$ (using Davison & McCarthy's, 1994, punishment version of the C-D model) with increases in COD length (presumably with $d_r$ remaining relatively constant).

One of the aims of the present experiment was to determine whether the large amount of undermatching observed in Experiment 1 was, at least to some extent, related to the length of the COD used. The other aim was to determine how the C-D model, and the punishment version of the C-D model, cope with changes in the length of the COD. Therefore, in the present experiment, the concurrent-schedule behaviour of possums was examined over a range of COD lengths.

# Method

## Subjects

Six brushtail possums were used in this experiment. Four of the possums were male, and two were female. The possums were named Static, Jasper, Izzie, Benny, Emma and Putzy. All possums had previous experience responding on concurrent schedules of reinforcement, in discrimination experiments. These possums were cared for in the same manner as those used in Experiment 1.

## Apparatus

The experimental equipment was identical to that used in Experiment 1.

## Procedure

The procedure used here differed from that used in Experiment 1 only in the conditions presented to the subjects. In addition to the concurrent VI 40-s VI 40-s, concurrent VI 180-s VI 22.5-s, and concurrent VI 22.5-s VI 180-s schedules used in Experiment 1, concurrent VI 100-s VI 25-s and concurrent VI 25-s VI 100-s schedules were presented. Each condition was presented with a COD length of 0 s, 2 s, 4 s and 6 s. The order of conditions is presented in Table 2.1. After Condition 6, the COD length was increased from 0 s to 2 s, with no intermediate COD lengths presented to the subjects. None of the subjects had previously experienced a COD of longer than 0 s, and 2 subjects (Static and Emma) continued to make frequent changeovers, resulting in zero reinforcers. After four sessions using a 2-s COD, the COD length used with these 2 subjects was reduced to 1 s for five sessions, increased to 1.5 s for a further two sessions, then increased again to 2 s. Condition 12 used extinction on the left lever (concurrent EXT VI 20-s). Izzie died during Condition 16, and was replaced by Putzy in Condition 20. All data were recorded as for Experiment 1.

Table 2.1
The order of conditions for Experiment 2, and the number of sessions required to reach stability in each condition.

| | Schedules (s) | | | |
|---|---|---|---|---|
| Condition | Left VI | Right VI | COD (s) | No. of Sessions |
| 1 | 40 | 40 | 0 | 23 |
| 2 | 180 | 22.5 | 0 | 22 |
| 3 | 22.5 | 180 | 0 | 21 |
| 4 | 100 | 25 | 0 | 29 |
| 5 | 25 | 100 | 0 | 24 |
| 6 | 40 | 40 | 0 | 19 |
| 7 | 40 | 40 | 2 | 23-33 |
| 8 | 180 | 22.5 | 2 | 16 |
| 9 | 22.5 | 180 | 2 | 22 |
| 10 | 100 | 25 | 2 | 20 |
| 11 | 25 | 100 | 2 | 22 |
| 12 | Ext | 20 | 2 | 18 |
| 13 | 40 | 40 | 2 | 32 |
| 14 | 40 | 40 | 4 | 27 |
| 15 | 180 | 22.5 | 4 | 23 |
| 16 | 22.5 | 180 | 4 | 22 |
| 17 | 100 | 25 | 4 | 30 |
| 18 | 25 | 100 | 4 | 28 |
| 19 | 40 | 40 | 4 | 17 |
| 20 | 40 | 40 | 6 | 33 |
| 21 | 180 | 22.5 | 6 | 30 |
| 22 | 22.5 | 180 | 6 | 21 |
| 23 | 100 | 25 | 6 | 20 |
| 24 | 25 | 100 | 6 | 20 |
| 25 | 40 | 40 | 6 | 39 |

# Results

Appendix B contains the raw data from the last five sessions of Conditions 1 to 25. All analyses were carried out on the data summed across these five sessions. All ratios were taken to the left manipulandum, and all logarithms are to the base 10. The data from Condition 12 (concurrent EXT VI 20-s) were not included when fitting the GML or the C-D model.

## The Generalised Matching Law

The logarithms of the response-allocation ratios are plotted against the logarithms of the obtained reinforcer-rate ratios for each possum at each COD length in Figure 2.1. The dotted line present on each graph represents strict matching (slope = 1.0, intercept = 0). The dashed lines represent the lines of best fit calculated using least-squares linear regression. The slopes (*a*), intercepts (log *c*), standard errors of the estimates (SE), and the percentages of variance accounted for (%VAC) by the lines describing the response-allocation data are given in Table 2.2. There were no consistent changes in the *a* values obtained from these data with changes in the COD length. However, for 3 of the 4 subjects who completed all conditions, the *a* values were higher with a 6-s COD than they were with either a 0-s or 2-s COD. In general, the sensitivity of the possums' response-allocation behaviour to changes in the reinforcer-rate ratio remained low at all COD lengths, with *a* values ranging from 0.28 (Benny, 6-s COD) to 0.84 (Izzie, 4-s COD). The bias measures (log *c*) were generally small, showing no consistent changes with changes in COD length. The %VAC measures were generally high, ranging from 85.98 to 99.48%, and did not change consistently with COD length, while the SE measures were low, ranging from 0.04 to 0.16, and again, there were no consistent changes with COD length. The %VAC and SE values indicate that the GML fits these data well.

Figure 2.2 shows the logarithms of the time-allocation ratios plotted against the logarithms of the obtained reinforcer-rate ratios for each possum at each COD length. As above, the dotted lines represent strict matching, while the

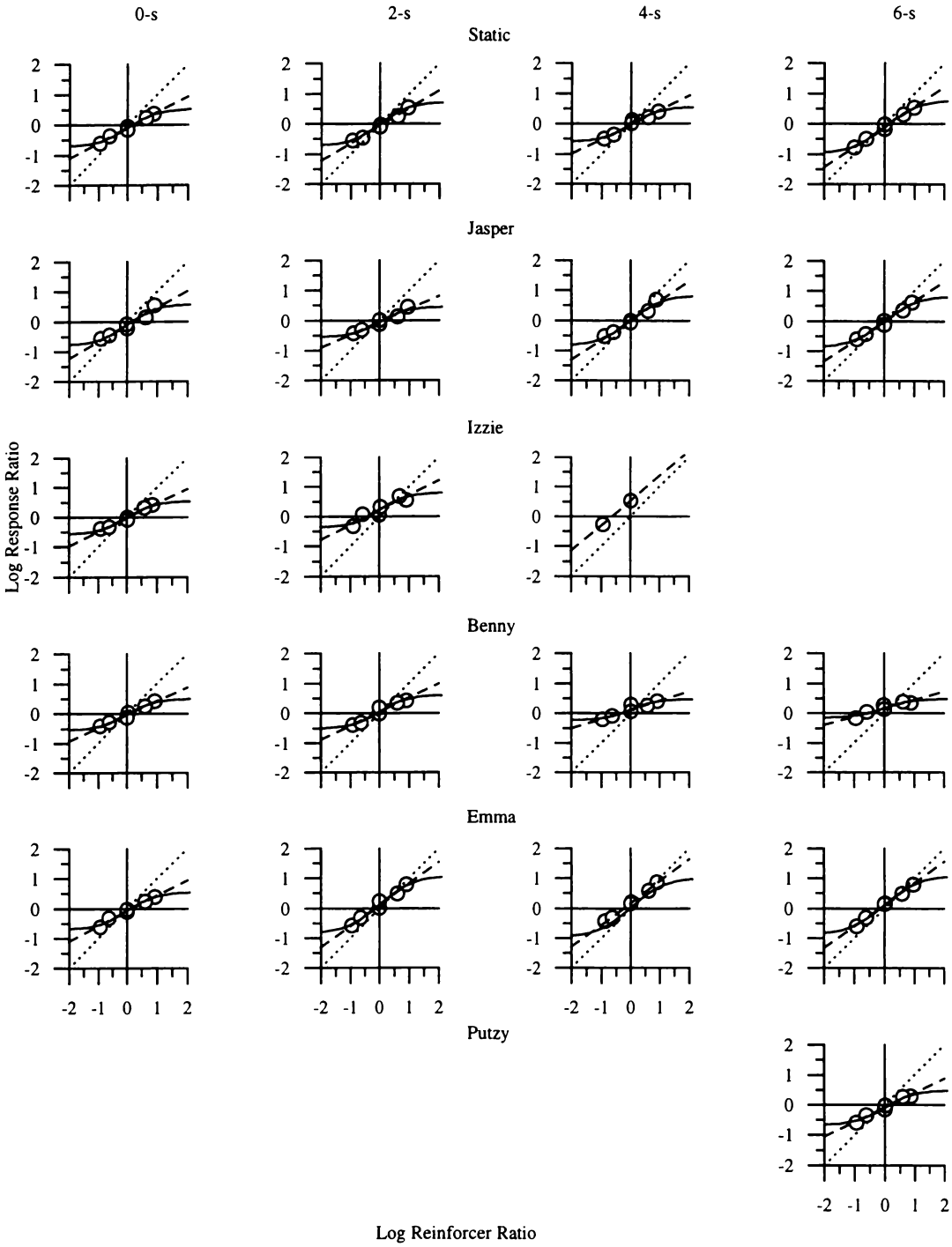


Figure 2.1. The logarithms of the response ratios plotted against the logarithms of the reinforcer-rate ratios for each subject at each COD length. The dashed line was fitted by the method of least squares to the data and the dotted line represents perfect matching. The solid line represents the function generated by the fit of the C-D model to the data using non-linear regression.

Table 2.2

Slopes ($a$), y-intercepts (log $c$), the percentage of variance accounted for (%VAC) and standard errors of the estimates (SE) for the lines of best fit for total response allocation (Figures 2.1 and 2.3), and within and post COD responding (Figure 2.3) at each changeover delay.

| | Total Responses | | | | Within COD | | | | Post COD | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Possum | ($a$) | (log $c$) | %VAC | SE | ($a$) | (log $c$) | %VAC | SE | ($a$) | (log $c$) | %VAC | SE |
| | | | | | | 0-s COD | | | | | | |
| Static | 0.51 | -0.09 | 98.71 | 0.05 | 0.00 | 0.02 | 0.01 | 0.05 | 0.68 | -0.12 | 98.91 | 0.06 |
| Jasper | 0.56 | -0.10 | 94.38 | 0.11 | 0.00 | 0.00 | 8.66 | 0.00 | 0.76 | -0.15 | 93.96 | 0.15 |
| Izzie | 0.48 | -0.01 | 97.52 | 0.06 | 0.00 | 0.00 | 0.28 | 0.01 | 0.67 | -0.02 | 97.83 | 0.08 |
| Benny | 0.45 | -0.02 | 97.49 | 0.06 | 0.00 | 0.00 | 9.37 | 0.00 | 0.59 | -0.03 | 97.29 | 0.08 |
| Emma | 0.51 | -0.07 | 97.94 | 0.06 | 0.00 | 0.00 | 22.11 | 0.00 | 0.68 | -0.10 | 98.61 | 0.06 |
| MEAN | 0.50 | -0.06 | 97.21 | 0.07 | 0.00 | 0.00 | 8.09 | 0.01 | 0.68 | -0.09 | 97.32 | 0.08 |
| | | | | | | 2-s COD | | | | | | |
| Static | 0.58 | -0.05 | 98.62 | 0.05 | -0.18 | -0.15 | 39.21 | 0.18 | 1.11 | -0.04 | 97.11 | 0.15 |
| Jasper | 0.43 | -0.05 | 94.71 | 0.08 | 0.00 | 0.01 | 0.43 | 0.06 | 0.88 | -0.09 | 95.73 | 0.15 |
| Izzie | 0.50 | 0.22 | 85.98 | 0.16 | 0.07 | 0.28 | 5.04 | 0.23 | 0.93 | 0.14 | 98.03 | 0.10 |
| Benny | 0.47 | 0.05 | 94.54 | 0.09 | 0.05 | 0.08 | 13.32 | 0.11 | 1.05 | -0.02 | 98.41 | 0.10 |
| Emma | 0.71 | 0.12 | 97.56 | 0.09 | 0.06 | 0.15 | 6.58 | 0.17 | 1.14 | 0.06 | 98.59 | 0.11 |
| MEAN | 0.54 | 0.06 | 94.28 | 0.09 | 0.00 | 0.07 | 12.92 | 0.15 | 1.02 | 0.01 | 97.58 | 0.12 |
| | | | | | | 4-s COD | | | | | | |
| Static | 0.48 | -0.02 | 95.55 | 0.08 | -0.34 | -0.01 | 66.34 | 0.19 | 1.17 | 0.01 | 97.53 | 0.15 |
| Jasper | 0.65 | 0.00 | 97.18 | 0.08 | 0.12 | 0.02 | 51.57 | 0.09 | 1.18 | -0.05 | 98.94 | 0.09 |
| Izzie | 0.84 | 0.53 | | | 0.15 | 0.59 | | | 1.35 | 0.43 | | |
| Benny | 0.31 | 0.12 | 88.11 | 0.09 | -0.22 | 0.17 | 69.22 | 0.12 | 0.92 | 0.04 | 99.81 | 0.03 |
| Emma | 0.73 | 0.18 | 99.48 | 0.04 | 0.10 | 0.32 | 53.62 | 0.07 | 1.26 | 0.02 | 99.68 | 0.06 |
| MEAN | 0.60 | 0.16 | 95.08 | 0.07 | -0.04 | 0.22 | 60.19 | 0.12 | 1.18 | 0.09 | 98.99 | 0.08 |
| | | | | | | 6-s COD | | | | | | |
| Static | 0.66 | -0.10 | 99.08 | 0.05 | -0.44 | 0.04 | 72.14 | 0.23 | 1.44 | -0.16 | 94.28 | 0.29 |
| Jasper | 0.66 | -0.02 | 98.63 | 0.06 | 0.21 | -0.07 | 66.31 | 0.12 | 1.00 | 0.05 | 99.60 | 0.05 |
| Putzy | 0.48 | -0.09 | 97.07 | 0.07 | 0.12 | -0.02 | 77.73 | 0.05 | 0.87 | -0.15 | 97.84 | 0.10 |
| Benny | 0.28 | 0.17 | 86.24 | 0.09 | -0.23 | 0.27 | 71.83 | 0.11 | 1.02 | -0.03 | 96.84 | 0.14 |
| Emma | 0.72 | 0.11 | 99.47 | 0.04 | -0.02 | 0.37 | 22.17 | 0.03 | 1.21 | -0.09 | 99.60 | 0.06 |
| MEAN | 0.56 | 0.01 | 96.10 | 0.06 | -0.07 | 0.12 | 62.04 | 0.11 | 1.11 | -0.07 | 97.63 | 0.13 |

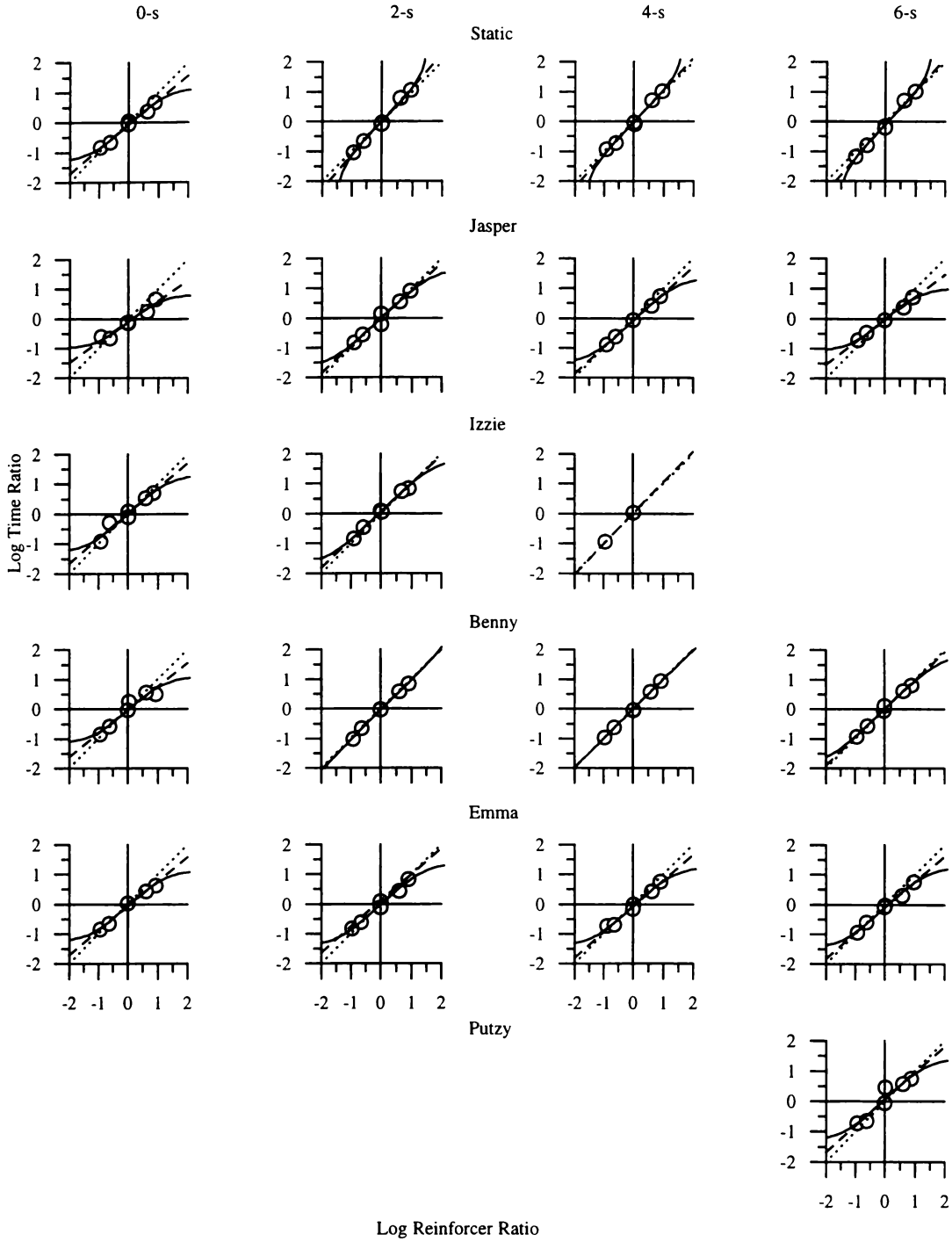


Figure 2.2. The logarithms of the time-allocation ratios plotted against the logarithms of the reinforcer-rate ratios for each subject at each COD length. The dashed line was fitted by the method of least squares to the data and the dotted line represents perfect matching. The solid line represents the function generated by the fit of the C-D model to the data using non-linear regression.

dashed lines are the lines of best fit. The values of *a*, log *c*, SE and %VAC for the time-allocation measures are given in Table 2.3. Generally, the values of *a* increased from the 0-s COD conditions to the 2-s COD conditions, but did not change consistently as the COD was increased beyond 2 s. For all subjects, the *a* values obtained from the time-allocation measures were greater than those obtained from the response-allocation measures (*a* values for time allocation ranged from 0.69 (Jasper, 0 s) to 1.14 (Static, 2 s)). As with response allocation, the bias measures obtained from the time-allocation data were small with no systematic changes with changes in COD length. The %VAC measures were high, ranging from 91.95 to 99.83%, and the SE measures were low, ranging from 0.03 to 0.22, indicating that the regression lines described the data well. Again, neither measure changed consistently with changes in the COD length.

It is difficult to observe any changes in the values of *a* or log *c* from Figures 2.1 and 2.2 alone. Therefore, within- and post-COD responding are not presented graphically here. Table 2.2 gives the values of *a* and log *c* as well as the SE and %VAC measures. It can be seen from Table 2.2 that there were no consistent changes in the within-COD measures of *a* in the data from individual subjects as the COD length increased. However, the mean within-COD *a* value became slightly more negative as the COD length was increased. Within-COD response-allocation was consistently less sensitive to changes in the reinforcer-rate ratio than total-response allocation with *a* values ranging from –0.44 (Static, 6-s COD) to 0.21 (Jasper, 6-s COD).

Bias within the COD also did not change consistently with changes in COD length and ranged from –0.15 to 0.59. There were also no consistent differences between the bias measures obtained from within-COD and total-response measures (in 11 of 20 cases, within-COD biases were greater). The %VAC measures obtained from the within-COD data were low, ranging from 0.01 to 77.73%, however, the SE measures were also low, ranging from 0 to 0.23.

The sensitivity measures obtained from the post-COD response measures increased from the 0-s COD conditions to the 2-s COD conditions for all subjects. For 4 of the 5 subjects, the sensitivity values increased again when the COD was

Table 2.3

Slopes ($a$), y-intercepts (log $c$), the percentage of variance accounted for (%VAC) and standard errors of the estimates (SE) for the lines of best fit for total time allocation (Figures 2.2 and 2.3), and PRP and Net time allocation at each changeover delay.

| | Total Time | | | | PRP Time | | | | Net Time | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Possum | ($a$) | (log $c$) | %VAC | SE | ($a$) | (log $c$) | %VAC | SE | ($a$) | (log $c$) | %VAC | SE |
| | | | | | | 0-s COD | | | | | | |
| Static | 0.82 | -0.07 | 98.10 | 0.09 | 0.96 | -0.02 | 97.79 | 0.11 | 0.70 | -0.11 | 81.84 | 0.26 |
| Jasper | 0.69 | -0.10 | 94.45 | 0.13 | 1.10 | -0.03 | 97.70 | 0.13 | 0.54 | -0.16 | 73.31 | 0.26 |
| Izzie | 0.84 | 0.01 | 94.62 | 0.15 | 1.11 | 0.06 | 97.50 | 0.13 | 0.57 | 0.00 | 77.66 | 0.23 |
| Benny | 0.79 | -0.03 | 91.95 | 0.19 | 1.03 | 0.00 | 99.83 | 0.03 | 0.53 | -0.01 | 51.20 | 0.41 |
| Emma | 0.82 | -0.06 | 98.27 | 0.09 | 1.13 | -0.05 | 99.61 | 0.06 | 0.69 | -0.06 | 96.32 | 0.11 |
| MEAN | 0.79 | -0.05 | 95.48 | 0.13 | 1.06 | -0.01 | 98.49 | 0.09 | 0.61 | -0.07 | 76.06 | 0.25 |
| | | | | | | 2-s COD | | | | | | |
| Static | 1.14 | 0.00 | 99.49 | 0.06 | 1.10 | 0.02 | 99.94 | 0.02 | 1.17 | -0.05 | 97.39 | 0.15 |
| Jasper | 0.92 | 0.00 | 97.13 | 0.12 | 1.03 | 0.02 | 99.93 | 0.02 | 0.79 | -0.04 | 90.35 | 0.20 |
| Izzie | 0.94 | 0.06 | 99.33 | 0.06 | 1.01 | 0.09 | 99.15 | 0.07 | 0.82 | -0.01 | 94.20 | 0.16 |
| Benny | 1.01 | -0.04 | 99.72 | 0.04 | 0.98 | -0.02 | 99.96 | 0.02 | 1.03 | -0.10 | 96.15 | 0.16 |
| Emma | 0.87 | -0.01 | 97.98 | 0.10 | 1.03 | -0.12 | 98.94 | 0.08 | 0.81 | 0.03 | 95.79 | 0.14 |
| MEAN | 0.98 | 0.00 | 98.73 | 0.08 | 1.03 | 0.00 | 99.58 | 0.04 | 0.92 | -0.03 | 94.78 | 0.16 |
| | | | | | | 4-s COD | | | | | | |
| Static | 1.09 | -0.02 | 99.18 | 0.08 | 1.09 | 0.01 | 99.78 | 0.04 | 1.10 | -0.05 | 97.87 | 0.13 |
| Jasper | 0.89 | -0.08 | 99.79 | 0.03 | 1.06 | -0.02 | 99.74 | 0.04 | 0.81 | -0.11 | 99.84 | 0.02 |
| Izzie | 1.03 | 0.02 | | | 0.91 | 0.02 | | | 1.18 | 0.03 | | |
| Benny | 1.00 | -0.01 | 99.83 | 0.03 | 0.99 | 0.00 | 99.64 | 0.05 | 1.00 | -0.04 | 99.79 | 0.04 |
| Emma | 0.86 | -0.07 | 98.50 | 0.08 | 0.93 | -0.19 | 96.80 | 0.13 | 0.84 | -0.04 | 98.57 | 0.08 |
| MEAN | 0.97 | -0.03 | 99.33 | 0.06 | 1.00 | -0.04 | 98.99 | 0.07 | 0.99 | -0.04 | 99.02 | 0.07 |
| | | | | | | 6-s COD | | | | | | |
| Static | 1.13 | -0.10 | 99.13 | 0.09 | 1.05 | -0.03 | 99.53 | 0.06 | 1.19 | -0.15 | 98.70 | 0.11 |
| Jasper | 0.75 | -0.03 | 99.36 | 0.05 | 1.03 | -0.01 | 99.75 | 0.04 | 0.65 | -0.05 | 98.58 | 0.06 |
| Putzy | 0.87 | 0.07 | 90.63 | 0.22 | 0.91 | 0.03 | 98.87 | 0.08 | 0.87 | 0.07 | 85.10 | 0.28 |
| Benny | 0.96 | 0.01 | 99.26 | 0.06 | 0.98 | -0.02 | 99.98 | 0.01 | 0.87 | 0.07 | 94.33 | 0.17 |
| Emma | 0.86 | -0.10 | 98.87 | 0.07 | 1.01 | -0.05 | 99.14 | 0.07 | 0.83 | -0.11 | 98.60 | 0.08 |
| MEAN | 0.91 | -0.03 | 97.45 | 0.10 | 1.00 | -0.01 | 99.45 | 0.05 | 0.88 | -0.03 | 95.06 | 0.14 |

increased to 4 s (the exception being Benny, whose sensitivity measure decreased). An increase in sensitivity with each increase in COD length (up to 6 s) was observed for only 1 subject (Static). The sensitivity measures obtained from the post-COD response measures were consistently greater than those obtained from the total response-allocation data.

As for the within-COD bias measures, there were no consistent changes in the post-COD bias measures with changes in COD length, and no consistent differences between the post-COD bias measures and total response-allocation bias measures (in 10 of 20 cases, the post-COD bias was larger). The %VAC measures were high for all subjects, ranging from 93.96 to 99.81%, and the SE measures were low, ranging from 0.03 to 0.29.

In order to see more clearly how sensitivity changed with changes in the COD length, the sensitivity measures obtained at each COD for the response, time, within-COD, and post-COD measures of behaviour are presented for each subject in Figure 2.3, along with the mean sensitivity obtained from all subjects. Since the sensitivity values for Putzy were obtained at only one COD length (6-s COD), these values are not presented here. These data were, however, included in calculations of the mean data. The solid lines on each graph represent strict matching ($a = 1.0$). There appears to be no consistent change in sensitivity in terms of the total response-based measures with increases in COD length. There were few changes in the mean response-allocation sensitivity measures with changes in COD length, although there was a slight increase from the 0-s to 2-s COD, and from the 4-s to 6-s COD. Similarly, there were no consistent changes in the individual time-allocation sensitivity measures with changes in COD length. The mean time-allocation sensitivity was lowest with the 0-s COD, but highest with the 2-s COD, decreasing slightly during the 4-s and 6-s COD conditions.

Behaviour within the COD was generally insensitive to changes in the reinforcer-rate ratio at all COD lengths, and there were no consistent changes in within-COD sensitivity measures with changes in the COD length. The post-COD response sensitivity measures increased from the 0-s to 2-s COD conditions

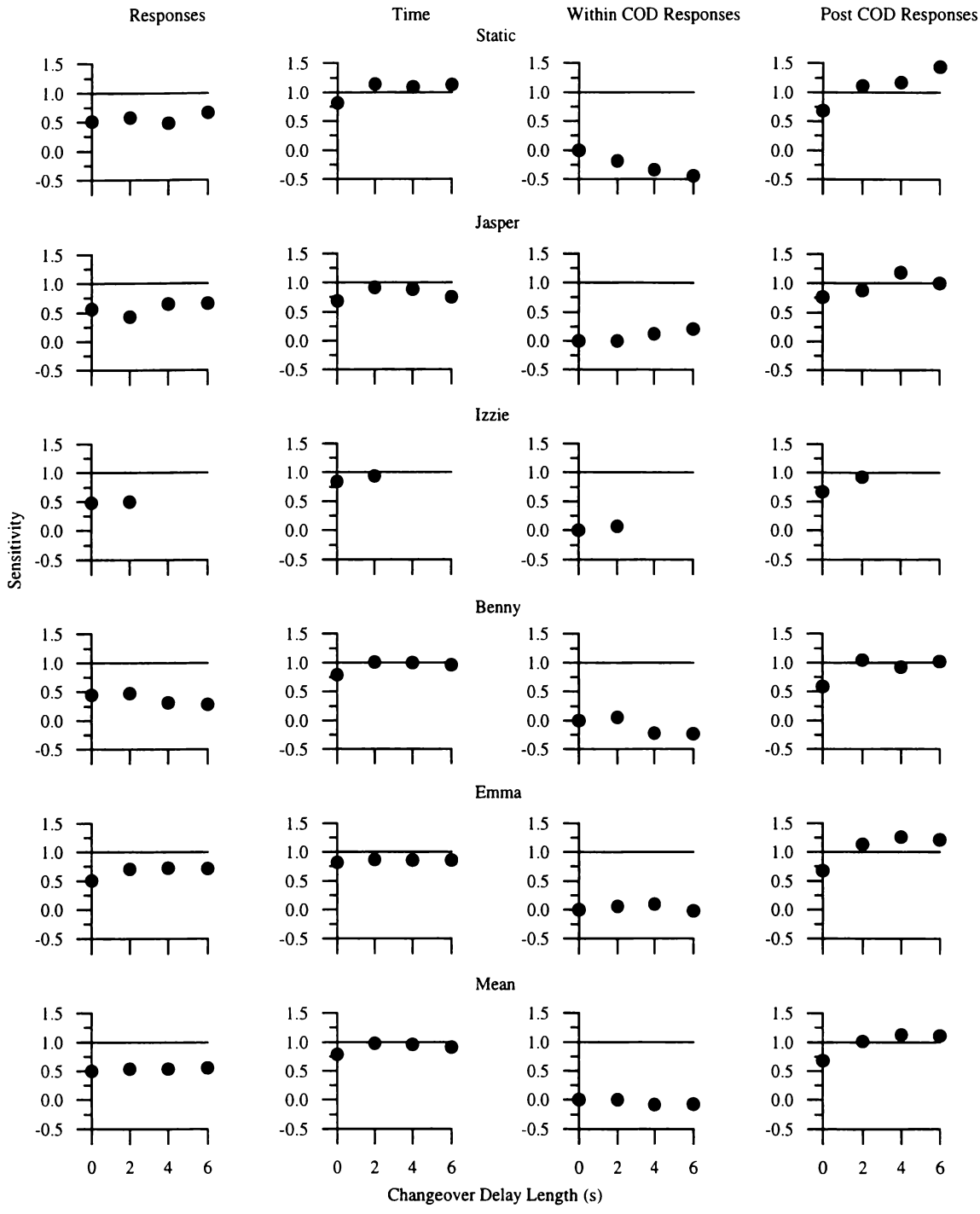


Figure 2.3. The estimates of sensitivity to changes in the reinforcer-rate ratio are plotted for each subject, at each COD length, for response- and time-allocation, and within- and post-COD responding. The solid line on each graph represents perfect matching.

for all subjects, to a value close to 1.0, and generally remained close to 1.0 in the 4-s and 6-s COD conditions (except in the case of Static with a 6-s COD).

The Contingency-Discriminability Model

The solid curves present on each graph in Figures 2.1 (log response ratios vs. log reinforcer-rate ratios) and 2.2 (log time ratios vs. log reinforcer-rate ratios) represent the lines of best fit calculated using non-linear regression, according to the C-D model. The central portion of these curves falls on the dashed line (matching line) with only the ends deviating, in most cases, in the direction of undermatching. However, with time allocation, there were three cases where the curves deviated in the direction of overmatching (Static: 2, 4 and 6-s COD). Again, it is difficult to observe any changes in these curves with changes in COD length.

The values of $d_r$, log $c$, and the %VAC measures are presented in Tables 2.4, and 2.5, for the response and time measures and for post-COD measures respectively. Values of $p_r$ ($p_r = d_r/(1+d_r)$) are also given in these tables. Changes in $p_r$ (and, therefore, changes in $d_r$) follow a similar pattern to changes in $a$ for all of these measures of behaviour. In other words, there were no consistent changes in discriminability in terms of response- and time-allocation as the COD length was increased. However, in four cases, negative values of $d_r$ were observed in the time-allocation data (in cases where $p_r$ is greater than 1.0). In these cases, the GML analysis gave $a$ values greater than 1.0 (overmatching). The C-D analysis also gave values of $p_r$ for post-COD response-allocation which changed in a similar fashion to the $a$ values from the GML analysis. That is, the $p_r$ values generally increased as the COD was increased up to 4 s. However, the $d_r$ values did not follow such a trend. In nine out of 19 cases, the value of $d_r$ obtained was negative (again, in all of those cases, overmatching was found using a GML analysis).

The %VAC measures were high for all measures of behaviour, and were very similar to the measures obtained using a GML analysis. The mean %VAC measures ranged from 94.3 to 99.3% with a GML analysis, and from 93.8 to

Table 2.4
Estimates of proportional discriminability ($p_r$), discriminability ($d_r$), bias ($\log c$), and the percentage of variance accounted for (%VAC) for the lines of best fit for response- (Figure 2.1) and time-allocation (Figure 2.2) at each changeover delay.

| | Response | | | | Time | | | |
|---|---|---|---|---|---|---|---|---|
| Possum | $p_r$ | $d_r$ | $\log c$ | %VAC | $p_r$ | $d_r$ | $\log c$ | %VAC |
| | | | | 0-s COD | | | | |
| Static | 0.80 | 4.10 | -0.09 | 97.97 | 0.94 | 16.66 | -0.07 | 98.04 |
| Jasper | 0.83 | 4.85 | -0.10 | 93.17 | 0.89 | 8.09 | -0.10 | 94.51 |
| Izzie | 0.78 | 3.64 | -0.01 | 98.30 | 0.95 | 19.65 | 0.01 | 94.05 |
| Benny | 0.77 | 3.39 | -0.02 | 97.34 | 0.93 | 13.26 | -0.03 | 92.70 |
| Emma | 0.81 | 4.16 | -0.07 | 96.89 | 0.94 | 15.73 | -0.06 | 98.51 |
| MEAN | 0.80 | 4.03 | -0.06 | 96.73 | 0.93 | 14.68 | -0.05 | 95.56 |
| | | | | 2-s COD | | | | |
| Static | 0.84 | 5.27 | 0.00 | 98.38 | 1.03 | -33.65 | 0.00 | 99.31 |
| Jasper | 0.76 | 3.21 | -0.05 | 92.74 | 0.98 | 43.99 | 0.00 | 97.12 |
| Izzie | 0.80 | 3.91 | 0.22 | 85.59 | 0.98 | 58.55 | 0.06 | 99.33 |
| Benny | 0.79 | 3.68 | 0.05 | 95.17 | 1.00 | -495.44 | -0.04 | 99.72 |
| Emma | 0.90 | 8.91 | 0.12 | 96.99 | 0.96 | 24.55 | -0.02 | 97.92 |
| MEAN | 0.82 | 5.00 | 0.07 | 93.78 | 0.99 | -80.40 | 0.00 | 98.68 |
| | | | | 4-s COD | | | | |
| Static | 0.79 | 3.72 | -0.02 | 95.15 | 1.02 | -49.28 | -0.02 | 99.04 |
| Jasper | 0.87 | 6.80 | 0.00 | 96.49 | 0.96 | 27.55 | -0.08 | 99.67 |
| Izzie | | | | | | | | |
| Benny | 0.69 | 2.28 | 0.12 | 87.14 | 1.00 | 1657.56 | -0.01 | 99.83 |
| Emma | 0.90 | 9.51 | 0.18 | 99.31 | 0.95 | 20.79 | -0.07 | 98.58 |
| MEAN | 0.81 | 5.58 | 0.07 | 94.52 | 0.98 | 414.15 | -0.05 | 99.28 |
| | | | | 6-s COD | | | | |
| Static | 0.88 | 7.46 | -0.10 | 98.74 | 1.03 | -38.06 | -0.10 | 98.87 |
| Jasper | 0.88 | 7.01 | -0.02 | 98.26 | 0.92 | 11.09 | -0.03 | 98.87 |
| Putzy | 0.79 | 3.74 | -0.09 | 96.65 | 0.96 | 22.69 | 0.07 | 90.89 |
| Benny | 0.67 | 2.07 | 0.17 | 84.98 | 0.99 | 75.20 | 0.01 | 99.27 |
| Emma | 0.90 | 9.38 | 0.11 | 99.03 | 0.96 | 23.23 | -0.10 | 98.50 |
| MEAN | 0.82 | 5.93 | 0.01 | 95.53 | 0.97 | 18.83 | -0.03 | 97.28 |

Table 2.5

Estimates of relative discriminability ($p_r$), discriminability ($d_r$), bias (log $c$), punishment ($w$), and the percentage of variance accounted for (%VAC) for the lines of best fit for post-COD response allocation at each changeover delay.

| Possum | *pr* | *dr* | log c | %VAC | *pr* | *dr* | log c | *w* | %VAC | *pr* | *dr* | log c | *w* | %VAC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 0-s COD | | | | | | |
| Static | 0.88 | 7.60 | -0.13 | 98.69 | 0.78 | 3.53 | -0.12 | 46.71 | 98.92 | | | | | |
| Jasper | 0.92 | 11.56 | -0.15 | 93.30 | 1.35 | -3.84 | -0.11 | -156.98 | 95.01 | 1.00 | infinity | -0.13 | -29.70 | 94.31 |
| Izzie | 0.88 | 7.30 | -0.02 | 98.43 | 0.83 | 5.04 | -0.02 | 17.08 | 98.55 | | | | | |
| Benny | 0.85 | 5.54 | -0.03 | 97.35 | 0.78 | 3.50 | -0.03 | 28.65 | 97.42 | | | | | |
| Emma | 0.89 | 7.90 | -0.10 | 98.10 | 73.06 | -1.01 | -0.10 | -37333.16 | 99.45 | 1.00 | infinity | -0.10 | -57.94 | 98.66 |
| MEAN | 0.88 | 7.98 | -0.09 | 97.17 | 15.36 | 1.44 | -0.08 | -7479.54 | 97.87 | | | | | |
| | | | | | | | | 2-s COD | | | | | | |
| Static | 1.02 | -41.11 | -0.04 | 96.98 | 0.94 | 15.94 | -0.04 | 27.88 | 97.01 | | | | | |
| Jasper | 0.96 | 27.42 | -0.09 | 95.48 | 2054.30 | -1.00 | -0.08 | -809132.16 | 96.07 | 1.00 | infinity | -0.09 | -809132.16 | 94.86 |
| Izzie | 0.98 | 48.62 | 0.14 | 97.92 | 0.77 | 3.38 | 0.15 | 65.23 | 98.95 | | | | | |
| Benny | 1.01 | -122.37 | -0.02 | 98.33 | 1.04 | -24.20 | -0.03 | -7.88 | 98.36 | 1.00 | infinity | -0.02 | 1.66 | 98.33 |
| Emma | 1.04 | -26.93 | 0.07 | 99.07 | 1.13 | -8.57 | 0.06 | -30.13 | 99.13 | 1.00 | infinity | 0.07 | 12.00 | 98.95 |
| MEAN | 1.00 | -22.87 | 0.01 | 97.56 | 411.64 | -2.89 | 0.01 | -161815.41 | 97.91 | | | | | |
| | | | | | | | | 4-s COD | | | | | | |
| Static | 1.03 | -30.76 | 0.01 | 97.03 | 0.90 | 8.57 | -0.01 | 40.43 | 97.17 | | | | | |
| Jasper | 1.05 | -22.35 | -0.05 | 99.19 | 0.64 | 1.77 | -0.08 | 144.47 | 99.97 | | | | | |
| Izzie | | | | | | | | | | | | | | |
| Benny | 0.98 | 43.94 | 0.04 | 99.82 | 1.18 | -6.71 | 0.04 | -51.44 | 99.84 | 0.98 | 44.31 | 0.04 | -0.07 | 99.82 |
| Emma | 1.06 | -16.93 | 0.02 | 99.80 | 1.01 | -73.61 | 0.02 | 14.52 | 99.88 | 1.00 | infinity | 0.02 | 18.46 | 99.87 |
| MEAN | 1.03 | -6.53 | 0.01 | 98.96 | 0.93 | -17.49 | -0.01 | 37.00 | 99.22 | | | | | |
| | | | | | | | | 6-s COD | | | | | | |
| Static | 1.06 | -16.78 | -0.15 | 91.88 | 1.33 | -4.00 | -0.25 | -70.33 | 94.79 | 1.00 | infinity | -0.13 | 12.46 | 90.78 |
| Jasper | 1.00 | 776.79 | 0.05 | 99.60 | 0.83 | 4.81 | 0.04 | 53.40 | 99.88 | | | | | |
| Putzy | 0.96 | 22.75 | -0.15 | 97.99 | 1.20 | -6.01 | -0.16 | -69.30 | 98.06 | 1.00 | 1536.74 | -0.15 | -11.85 | 98.06 |
| Benny | 1.01 | -179.80 | -0.03 | 96.83 | 1.97 | -2.03 | 0.03 | -232.38 | 97.86 | 1.00 | infinity | -0.03 | 0.76 | 96.81 |
| Emma | 1.05 | -21.78 | -0.09 | 99.76 | 0.96 | 27.25 | -0.07 | 23.84 | 99.90 | | | | | |
| MEAN | 1.01 | 116.24 | -0.07 | 97.21 | 1.26 | 4.00 | -0.08 | -58.96 | 98.10 | | | | | |

99.3% with a C-D analysis.

Since there is such a large range of $d_r$ values, it is difficult to plot changes in $d_r$ with changes in COD length. Therefore, values of $p_r$ (which should theoretically fall between 0.5 and 1.0) were plotted against COD length in Figure 2.4 for response-allocation, time-allocation and post-COD response-allocation, for each subject. The mean values of $p_r$ are also plotted here. Changes in $p_r$ follow a very similar pattern to changes in $a$ with changes in the COD length, however the values of $p_r$ tend to be slightly larger from response allocation, and slightly smaller from time allocation and post-COD response allocation.

Since the post-COD response-allocation measures gave $p_r$ values greater than 1.0 in several cases, Davison and McCarthy's (1994) punishment version of the C-D model (Equation 0.7) was fitted to these data (Table 2.5). The use of this version of the model resulted in 10 cases where the value of $d_r$ was negative (compared to nine cases with the original C-D model). In six of these cases, the original model had not given a negative $d_r$ value. In addition, when using this version of the model, there were no longer any consistent changes in $p_r$ from post-COD responding with changes in the COD length.

The values of $w$ obtained ranged from –809,132 (reinforcers lost per minute due to changing over; Jasper, 2-s COD) to 144 (Jasper, 4-s COD). There were no consistent changes in $w$ with changes in COD length. The bias measures obtained from the two versions of the C-D model were very similar, and the %VAC measures were higher for the punishment version of the C-D model than the original C-D model (means ranging from 97.87 to 99.22% and from 97.17 to 98.96%, respectively).

Extinction

Figure 2.5 shows the proportion of responses, times and post-COD responses on the right lever (filled circles) for each subject from Condition 12 (concurrent EXT VI 20, 2-s COD). The unfilled circles represent the proportions predicted by the C-D model, calculated using the obtained values of $d_r$ and $c$ as follows. The ratio of responses predicted by the C-D model ($B_1/B_2$) can be

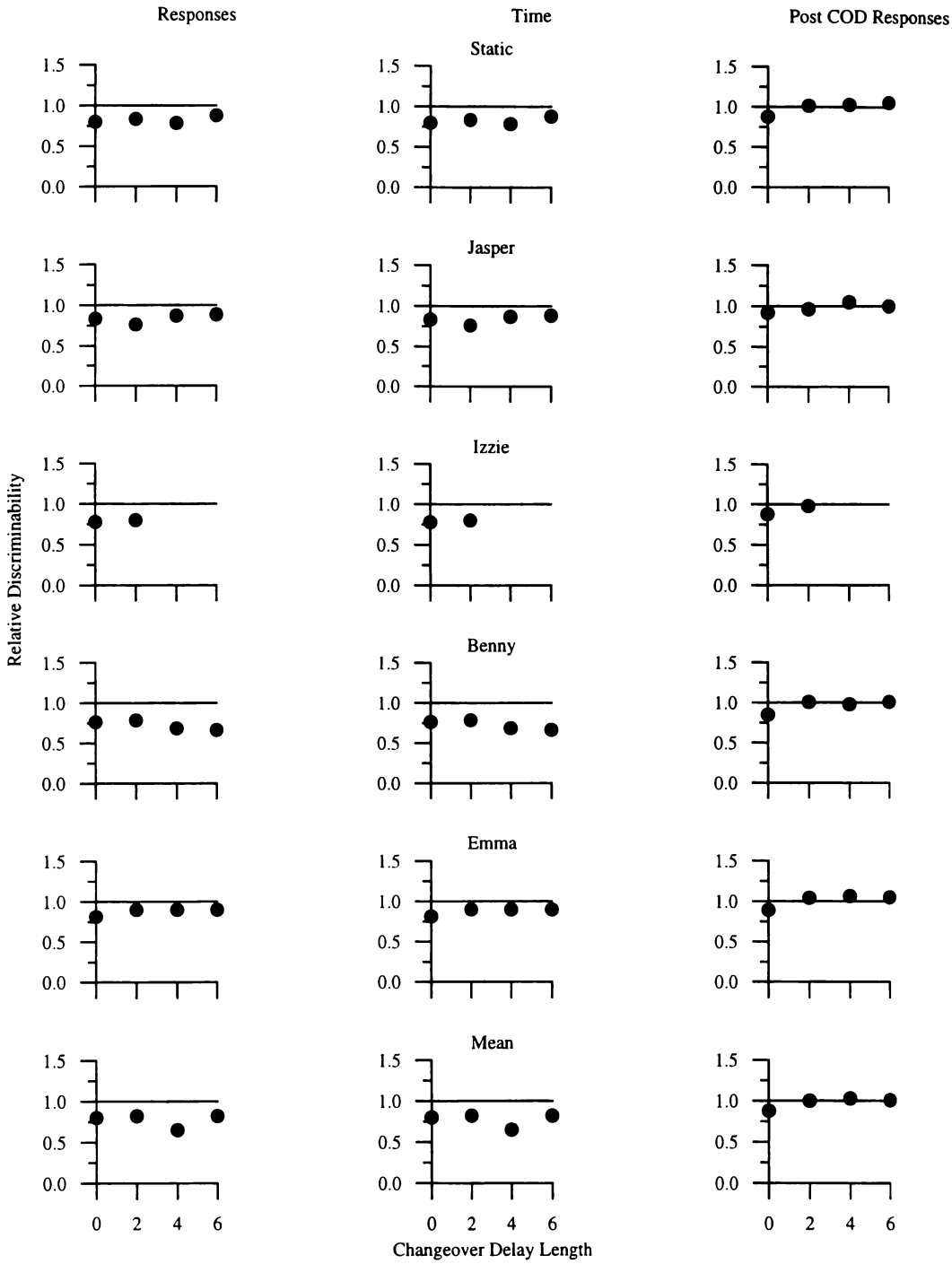


Figure 2.4. The estimates of relative discriminability of the response-reinforcer contingencies are plotted for each subject, at each COD length, for response- and time-allocation, and post-COD responding. The solid line on each graph represents perfect discriminability.

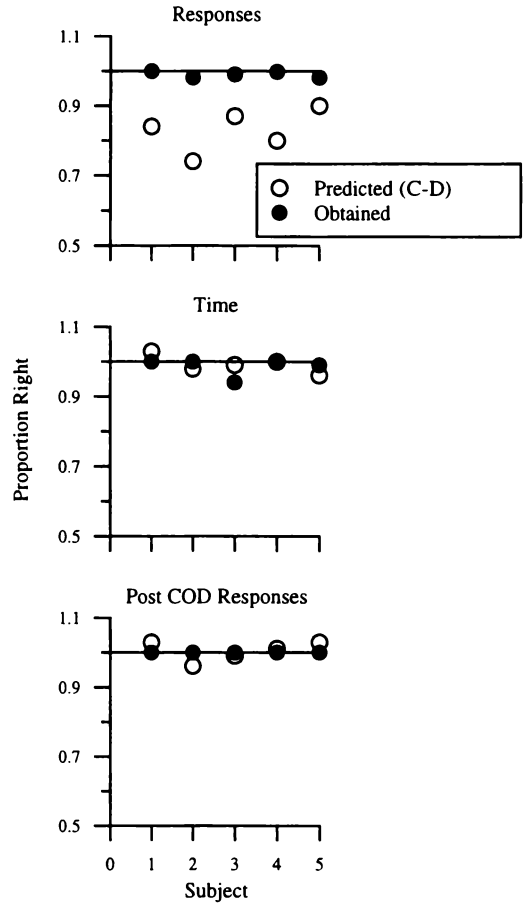


Figure 2.5. The proportion of responses made to the extinction alternative during the concurrent EXT VI 20 condition with a 2-s COD (filled circles), and the proportion of responses predicted by the C-D model (unfilled circles) based on the estimates of discriminability and bias calculated using the data obtained during the remaining 2-s COD conditions for each subject. The solid line represents perfect matching and perfect discriminability. Subject numbers correspond to possums as follows: 1 = Static, 2 = Jasper, 3 = Izzie, 4 = Benny, 5 = Emma.

calculated using Equation 0.5. In order to calculate the proportion of responses predicted, it is necessary to calculate $B_1/(B_1+B_2)$. Since $B_1/B_2 = cd_r$ (which is equivalent to $cd_r/1$, where $B_1 = cd_r$ and $B_2 = 1$), $B_1/(B_1+B_2) = cd_r/(cd_r+1)$. The solid lines represent the proportion predicted by the GML (1.0; exclusive right responding). With all measures, the obtained proportion of behaviour allocated to the right lever was close to 1.0, as predicted by the GML. The C-D model predicted that a much smaller proportion of responses would be allocated to the right lever (top panel), while the obtained proportions of time (centre panel) and post-COD responses (bottom panel) were similar to those predicted by the C-D model (i.e., the GML and the C-D model predictions were very similar in these two cases). It should be noted that in those cases where a negative value of $d_r$ was obtained, the proportion of right responses predicted by the C-D model is greater than 1.0 (a result which is impossible to obtain). This occurs because the numerator must be a larger negative number than the denominator (which equals the numerator plus one). For example, if $d_r = -2$, and $c = 1$, $cd_r/(cd_r+1) = -2/-1$. Division of these two negative numbers gives a positive number greater than 1.0 (in this case, 2).

Changeover Rates

The rates of changing over are plotted against the logarithms of the time-allocation ratios for each COD length for all possums in Figure 2.6. When the COD was 2, 4 and 6 s, an inverted U-shaped function can be seen in the data from most subjects when plotted against the time-allocation ratios. This was not the case when the COD was 0 s. When the same data were plotted against the logarithms of the reinforcer-rate ratios, the graphs looked very similar to those in Figure 2.6, and therefore, are not presented here.

The left panel of Figure 2.7 shows changes in the changeover rates as the COD was increased for each possum for the average of the two equal-schedule conditions (concurrent VI 40 s VI 40 s; unfilled circles) and one unequal-schedule condition (concurrent VI 180 s VI 22.5 s; pluses). Generally, the rates of changing over decreased as the length of the COD was increased. The rates of

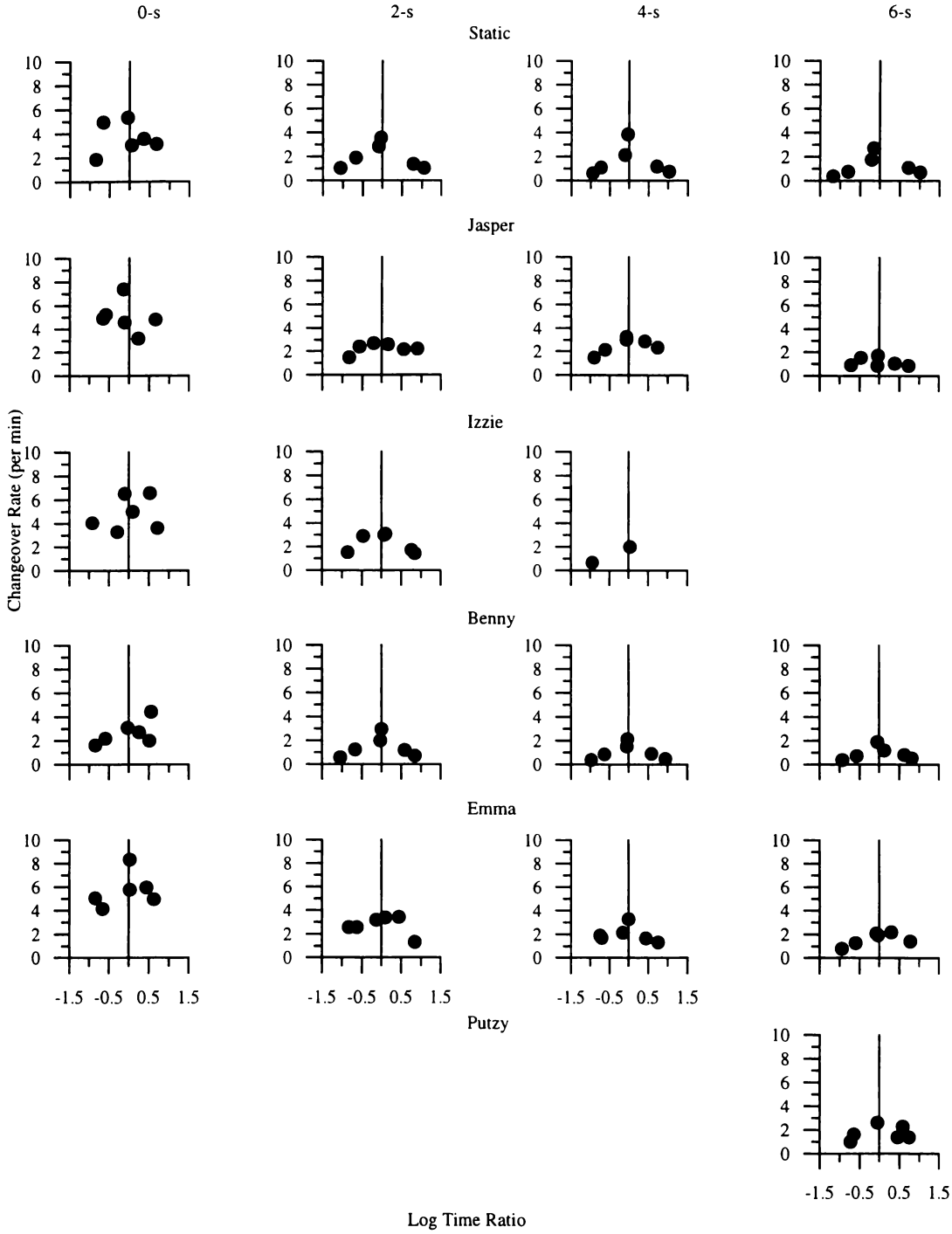


Figure 2.6. The rates of changing over plotted against the logarithms of the time-allocation ratios for each possum at each COD length.

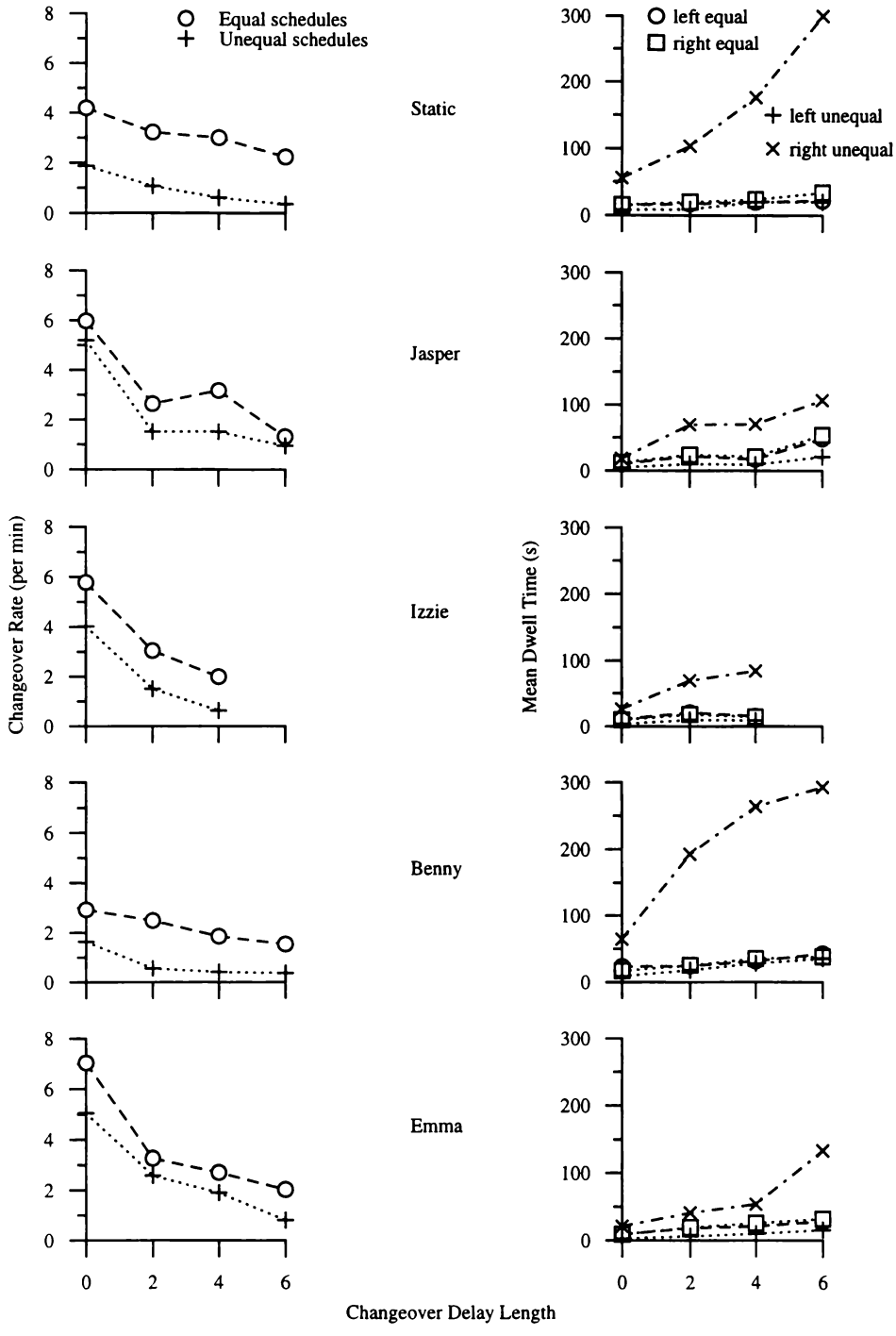


Figure 2.7. The changeover rate and the mean dwell time are plotted against the COD length for two sets of schedules (one equal schedules condition and one unequal schedules condition) for each subject.

changing over with a 0-s COD varied largely across subjects, from approximately seven changeovers per minute (Emma) to approximately three changeovers per minute (Benny) with equal schedules of reinforcement. There was less variability in the changeover rates with the 6-s COD (between 1.5 and 2.5 changeovers per minute). In all cases, the rates of changing over were lower in the unequal-schedules conditions than during the equal-schedules conditions.

The right panel of Figure 2.7 shows the mean dwell time (time between changeovers) on each lever plotted against the length of the COD for each possum (except Putzy) for the average of the two equal-schedules conditions (concurrent VI 40 s VI 40 s; left lever: unfilled circles; right lever: unfilled squares) and one unequal-schedules condition (concurrent VI 180 s VI 22.5 s; left lever: pluses; right lever: crosses). These data are taken from the same schedules as were used in the graphs presented in the left panel. In general, the mean dwell time increased with increases in the length of the COD.

The average number of responses during each second following a changeover were calculated, for the first equal-schedules condition and the first unequal schedules condition presented at each COD length, as described in the Discussion section of Experiment 1. These data are plotted in Figures 2.8 (equal schedules) and 2.9 (unequal schedules). Data for Izzie and Putzy are not presented here, as these subjects did not complete all conditions. The vertical dashed lines on these graphs represent the end of the COD. It can be seen from both of these figures that the response rates were generally highest during the COD, decreased during the first few seconds following the end of the COD, and remained low until the next CO response was made. With unequal schedules of reinforcement, there was a tendency for the response rate on the rich schedule (right lever) to reduce at a slower rate than that on the lean schedule. The maximum response rate observed was approximately three responses per second. This did not vary across conditions or COD lengths. Overall, there were no consistent differences in the response rates on each lever within the COD. Some subjects did appear to respond consistently faster on one lever than the other, however the lever associated with the faster response rate varied across subjects.

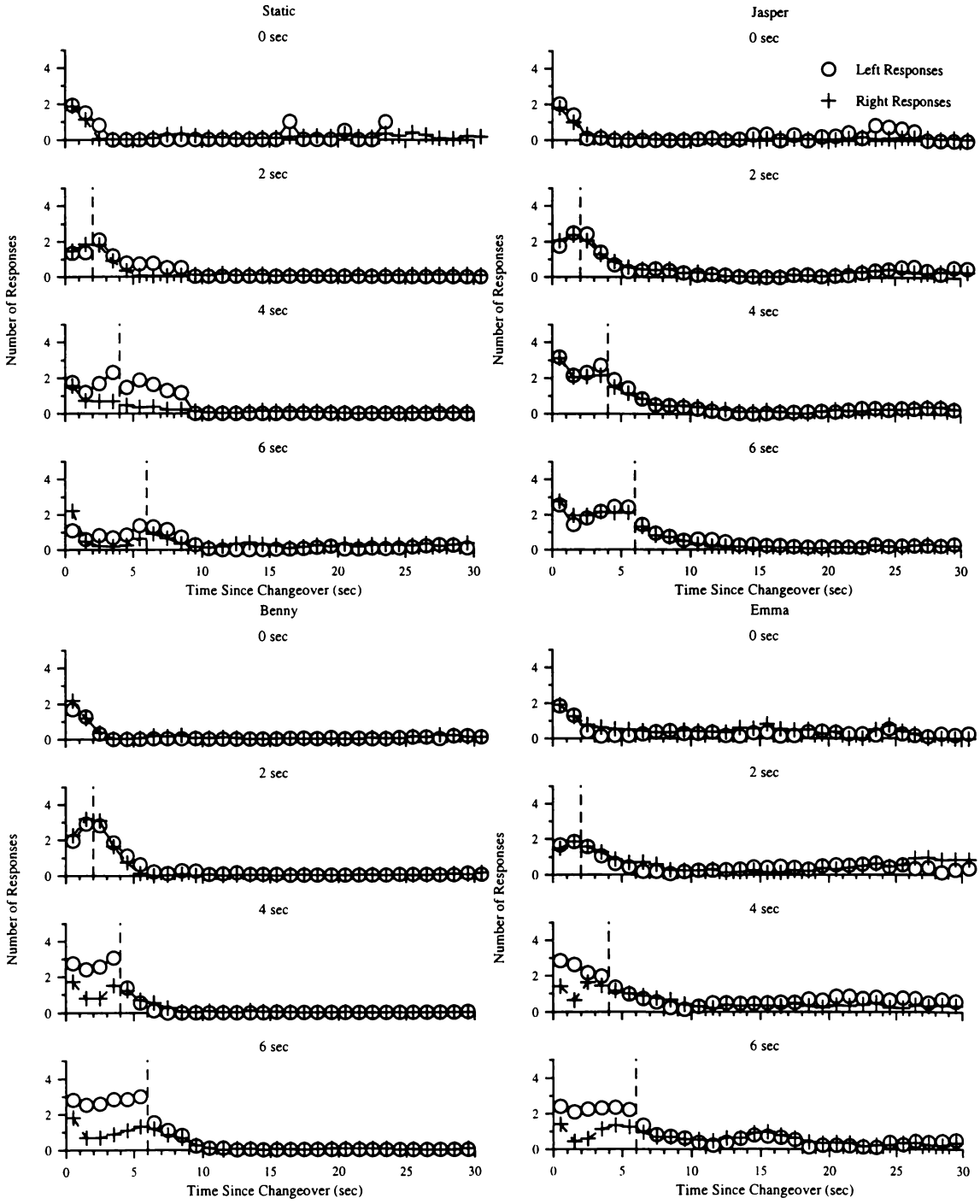


Figure 2.8. The average number of responses during each second following a changeover for each possum and each COD length with concurrent VI 40-s VI 40-s schedules. The dashed line represents the end of the changeover delay.

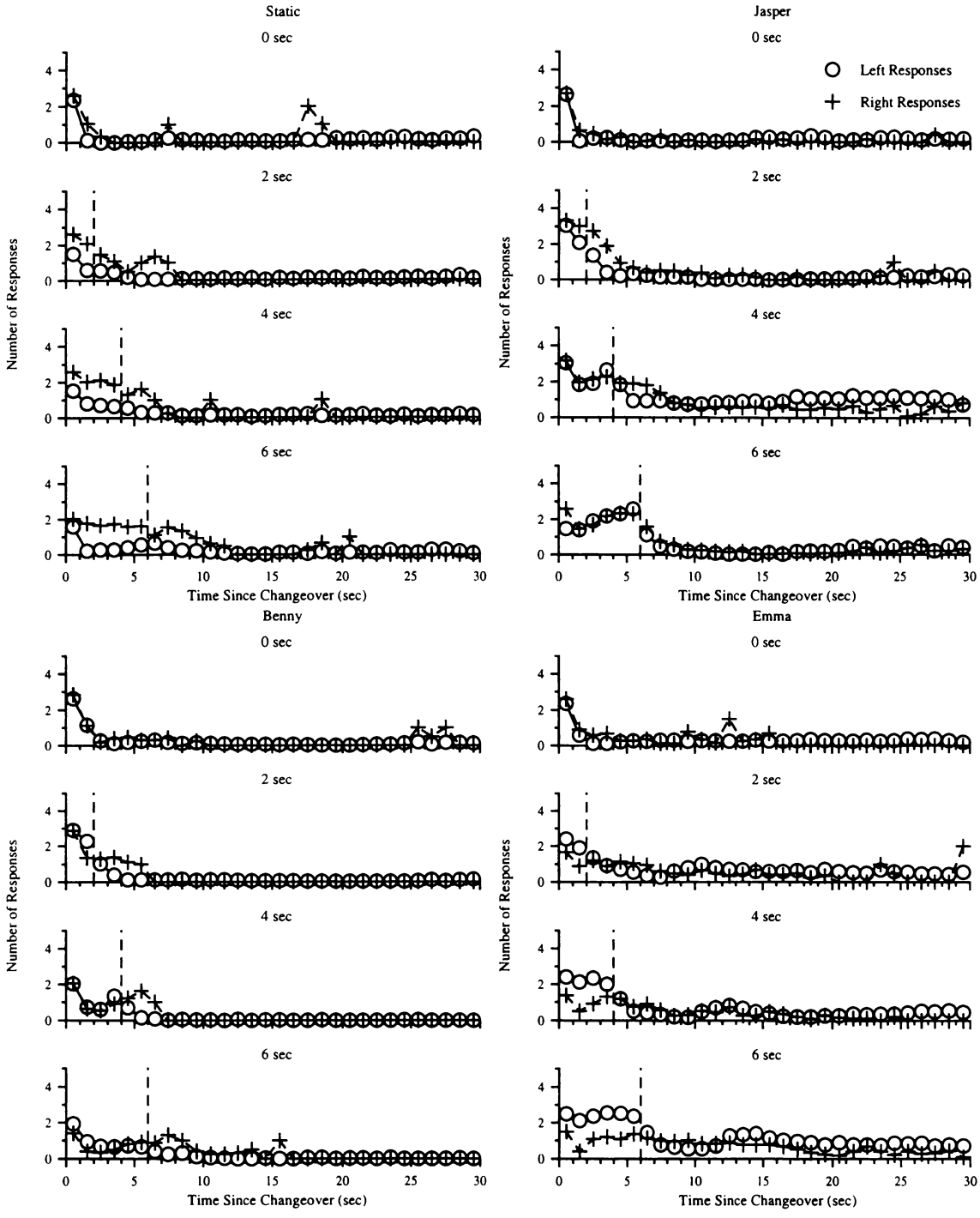


Figure 2.9. The average number of responses during each second following a changeover for each possum and each COD length with concurrent VI 180-s VI 22.5-s schedules. The dashed line represents the end of the changeover delay.

Response Rates

The local rates of responding on both the left (unfilled circles) and right levers (pluses) are plotted in Figure 2.10 for each possum at each COD length. In most cases (17 out of 20), the local rate of responding was consistently higher on the lever associated with the lower rate of reinforcement. In three cases (Emma: 2, 4 and 6-s COD) the local rate of responding on the left lever was consistently higher than that on the right lever (for all but one schedule pair when the COD was 2 s). There were no consistent changes in the local rates of responding with changes in COD length.

Figure 2.11 shows the absolute rates of responding on the left (unfilled circles) and right levers (pluses) for each possum at each COD length. In all cases the absolute rates of responding on a lever increased as the reinforcer rate associated with that lever increased. For all but 1 subject, there were no consistent changes in the absolute rates of responding with changes in COD length. For the remaining subject (Emma), the absolute response rates on the left lever, at low reinforcement rates, increased from the 0-s to the 2-s COD conditions, and increased again from the 4-s to the 6-s COD conditions.

## Discussion

Increasing the length of the COD in the present experiment had no consistent effect on the total response-allocation behaviour of possums. The mean sensitivity to reinforcement ($a$) across possums at each COD ranged from 0.5 (0-s COD) to 0.6 (4-s COD). These values are similar to those reported in Experiment 1, where a different group of possums were presented with a range of concurrent VI VI schedules of reinforcement with a 2-s COD (mean $a = 0.51$). In terms of total-time allocation, as the length of the COD was increased from 0 to 2-s, the mean sensitivity to reinforcement increased from 0.79 to 0.98, with no further consistent changes with increases in COD length. The mean sensitivities to reinforcement obtained with CODs of 2, 4 and 6 s were similar to that observed in Experiment 1 with a 2-s COD (mean $a = 0.96$).

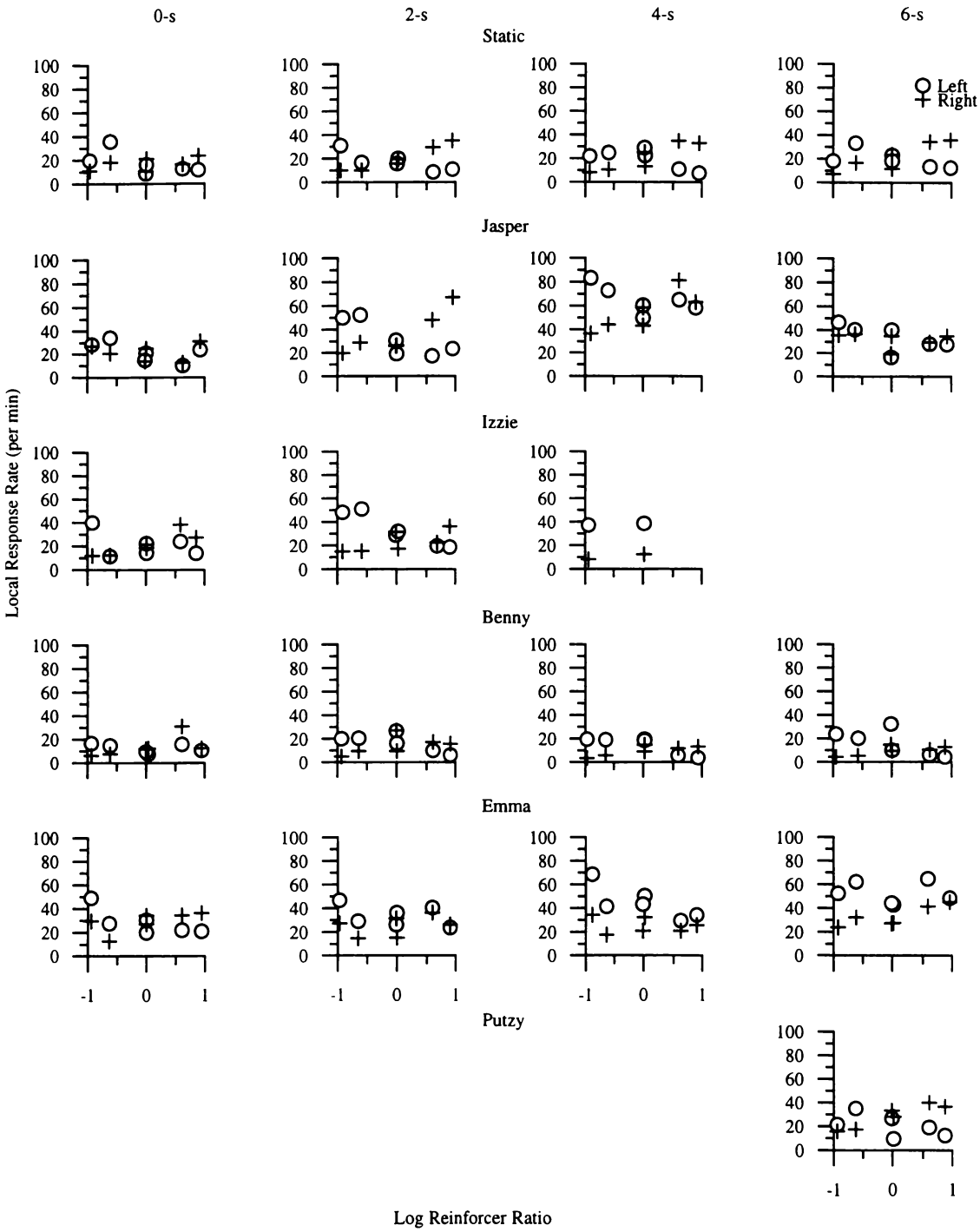


Figure 2.10. The local response rates on the left and right manipulanda plotted as functions of the logarithms of the obtained reinforcer ratios for each possum at each COD length.

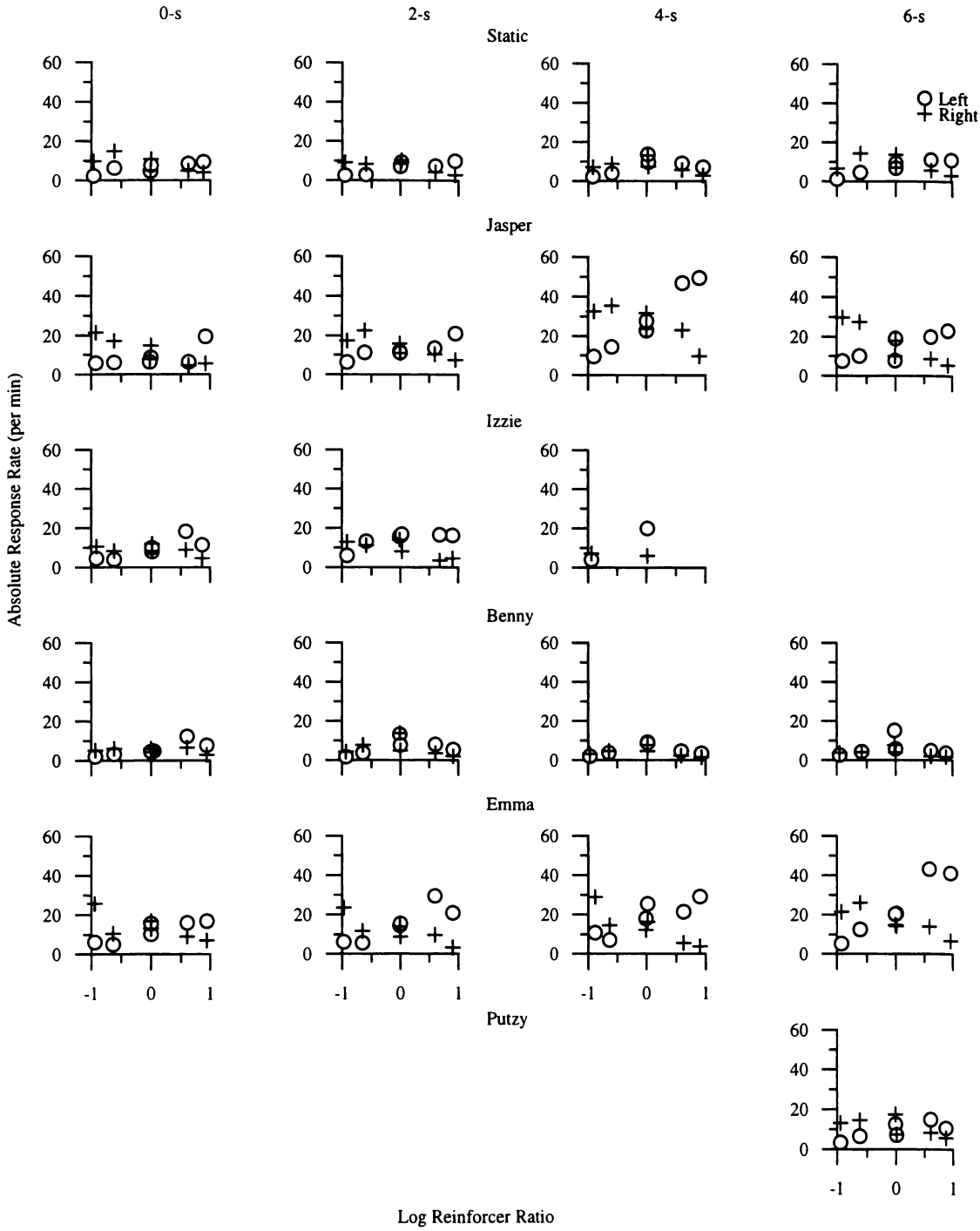


Figure 2.11. The absolute response rates on the left and right manipulanda plotted as functions of the logarithms of the obtained reinforcer ratios for each possum at each COD length.

In a similar study with hens, Temple et al. (1995) found that the mean sensitivity value increased from 0.63 with no COD to 0.79 with a 2-s COD for response allocation, and from 0.65 to 0.82 for time allocation (with no consistent changes in individual subjects' data with further increases in the COD length). Other studies have shown similar patterns with increasing COD length (Shull & Pliskoff, 1967; Silberberg & Schrot, 1974). Only the time-allocation data from the present experiment are consistent with these results. However, several studies have failed to observe the increases in sensitivity found in the above studies (e.g., Allison & Lloyd (1971), Silberberg & Fantino (1970), and Stubbs & Pliskoff (1969) found no change in the degree of matching with increases in COD length), which is consistent with the response-allocation data in the present experiment.

As previously mentioned, Baum (1979) and deVilliers (1977) have suggested that some minimum COD length may be necessary for matching, and that beyond this length matching will always be found. However, for 1 subject in Temple et al.'s (1995) study, the value of *a* did not increase to 1.0 but still reached a maximum value (>1.0) with a COD of 2 s, following a similar pattern to the other subjects' data. This suggests that a minimum COD length may be necessary for the closest approximation to matching, but that 'perfect' matching will not always be obtained. The smallest COD used in those studies which did not find any change in sensitivity was 0 s (Stubbs & Pliskoff, 1969). This requires at least two responses on each key before a reinforcer can be obtained. This was also the shortest COD arranged in the present experiment. The actual length of time taken to complete a changeover will vary across subjects depending on response rates. The failure to improve matching in those studies and the present experiment may have been due to the time taken to complete each CO equalling or exceeding the minimum length required for the closest approach to matching. Had a no-COD condition been conducted in the present experiment, it may have resulted in a lower sensitivity to reinforcement for response allocation (as was found by Temple et al., 1995). This would support the idea that introducing a COD does improve matching up to a point, but that once the maximum sensitivity for a subject has been reached, further increases in COD length will have no effect on

matching behaviour. To date, no studies have included both no-COD and 0-s COD conditions. Doing so would help clarify this issue.

Temple et al. (1995) and Baum (1982) have suggested that since responding within the COD is discriminated by the subject (indicated by insensitivity to the reinforcer rate ratio), it should be removed from the response-allocation data prior to analysis. Responding within the COD in the present experiment was insensitive to changes in the reinforcer-rate ratio at all COD lengths, with *a* values being consistently small and/or negative, suggesting that behaviour during this period was not under the control of the arranged schedules of reinforcement. This result was also observed in Experiment 1, and provides support for Temple et al.'s and Baum's suggestion.

Post-COD responding was consistently more sensitive to changes in the reinforcer-rate ratio than total responding. Unlike the total response-allocation data, the mean post-COD response-allocation sensitivity increased from the 0-s COD condition to the 2-s COD condition, to a value close to 1.0, with no systematic variation with further increases in COD length. The mean sensitivity from the post-COD response data was slightly above 1.0 for all but the 0-s COD. When only post-COD responding is considered, the results of the present experiment are consistent with the idea that some minimum COD length may be necessary for matching. The sensitivity of post-COD responding to changes in the reinforcer-rate ratio in the present experiment was similar to that observed in previous studies. The mean post-COD *a* values in the present experiment ranged from 1.02 to 1.18 (not including the 0-s COD condition), while other studies have found mean post-COD *a* values in the range of 1.06 to 1.19 (McAdie et al., 1996; Shahan & Lattal, 1998; Temple et al., 1995).

The sensitivity of post-COD responding with a 2-s COD (mean $a = 1.02$) in the present experiment was greater than that observed in Experiment 1 (mean $a = 0.77$, 2-s COD). The procedures used in these experiments were identical in all respects. Only the subjects and their previous experience differed. Todorov, Oliveira Castro, Hanna, Bittencourt de Sa and Barreto (1983) reported that sensitivity to reinforcement in concurrent-schedule performance decreased as the

number of conditions increased, and increased as the number of sessions per condition increased. This does not explain the differences in *a* values observed in the present experiments. The subjects used in Experiment 1 had previously been exposed to five multiple-concurrent-schedule conditions (Muir, 1997), while during Experiment 1 they were exposed to only four simple-concurrent conditions. Overall, the subjects in the present experiment had been exposed to a larger number of conditions by the end of the 2-s COD conditions (13 in total). Based on Todorov et al.'s findings, the *a* values of these subjects should have been lower than those found in Experiment 1. The number of sessions per condition did not vary systematically across the experiments, therefore this should not have influenced the obtained *a* values.

Changeover Rates

At all COD lengths, the changeover rate decreased as the reinforcer rates on the two schedules became more different, giving an inverted U-shaped function. This is a common finding, which was also found in Experiment 1, and has been reported by Baum (1974), Catania (1963), Herrnstein (1961) and Sumpter et al. (1995). In this experiment, and those of Baum (1976) and Miller (1976) the relationship also held for both response- and time-allocation ratios.

The rate of changing over decreased with increases in COD length for all subjects. The mean rate of changing over with equal schedules of reinforcement decreased from 5.2 per minute with a 0-s COD to 1.8 per minute with a 6-s COD. This decreased rate in changing over with increases in COD length has been observed in several studies (e.g., Shull & Pliskoff, 1967; Silberberg & Fantino, 1970; Stubbs & Pliskoff, 1969; Temple et al., 1995). The rate of changing over with a 2-s COD in the present experiment was lower than that observed in Experiment 1 (2.9 vs. 3.6), however, this rate of changing over is still more similar to that observed with rats than with pigeons or hens.

Temple et al. (1995) presented dwell-time data for hens at each COD length. The dwell time is the average amount of time spent on each schedule between changeovers, and is the inverse of the CO rate. The dwell times observed

in the present experiment were longer than those observed by Temple et al. With a 2-s COD, Temple et al. reported a dwell time of approximately 10 s, compared with 21 s in the present experiment, while with a 4-s COD, dwell times ranged from 10-20 s for Temple et al.'s subjects, with a mean of 22 s in the present experiment. The long dwell times found here are consistent with the low CO rates reported above, and these different patterns of responding compared with other species may have contributed to the large amount of undermatching observed in the present experiment.

Response Rates

In all cases, the response rates in the present experiment were higher during the COD and decreased during the first few seconds following the end of the COD to a level which was maintained until the next CO. A similar pattern of behaviour has also been reported in studies using other species (e.g., Bourland & Miller, 1978; Dreyfus et al., 1982; Pliskoff, 1971; Shahan & Lattal, 2000). This elevated response rate has been attributed to the increased probability of reinforcement following a CO response (Catania, 1962; Silberberg & Fantino, 1970). Dreyfus et al. (1982) found that the majority of reinforcers are obtained just after changing over to the lean schedule. Consistent with this finding, Pliskoff, Cicerone and Nelson (1978) found that with a 2-s COD, responding occurred at the highest rate during the second 1-s interval following a changeover, while Silberberg and Fantino (1970) reported that the rate of responding within the COD was higher on the lean schedule. While these specific patterns of behaviour were not observed in the present experiment, the fact that the rate of responding during the COD was consistently higher than the post-COD response rate for all subjects at all COD lengths is consistent with the an increased probability of reinforcement, and provides further support for Temple et al. (1995) and Baum's (1982) suggestion that behaviour during the COD is discriminated by the subjects, and can therefore be removed from response measures of behaviour before analysis.

In general, the absolute response rates on a lever increased as the rate of

reinforcement on that lever increased, while the local response rates were inversely related to the rate of reinforcement. These patterns of responding were also found in Experiment 1, and are consistent with previous research (Baum, 1979; Davison & Ferguson, 1978; Herrnstein, 1961). The actual local and absolute rates of responding were similar to those observed in Experiment 1, and were therefore also lower than those typically obtained with other species (Baum, 1976; Bradshaw et al., 1979; Davison & Hunter, 1976; Herrnstein, 1961; Ruddle et al., 1979). Rates of responding did not change with changes in COD length, which is consistent with the finding that values of *a* did not change with COD length.

The Contingency-Discriminability Model

In all cases when the C-D model was used to describe the data from the present experiment, changes in $p_r$ followed a similar pattern to changes in sensitivity (*a*) with a GML analysis. This suggests that, for time-allocation and post-COD response-allocation, discriminability ($d_r$; $p_r = d_r/(1+d_r)$) increased when the COD length was increased from 0 s to 2 s, with no increases in discriminability with further increases in COD length. However, in several cases, $p_r$ was greater than 1.0. In such cases, the value of $d_r$ is negative and un-interpretable. As previously mentioned, Davison and Jenkins (1985) stated that when overmatching is found for time-allocation data with a GML analysis, this is simply the result of statistical error, and should be treated as perfect matching, and therefore, perfect discriminability. A different approach was suggested for dealing with post-COD responding. In such cases, it was suggested that overmatching was the result of the punishing effect of the COD. For these data, Davison and McCarthy (1994) presented a punishment version of the C-D model (Equation 0.7). Since overmatching was found with a 2-s COD in the present experiment (suggesting that the 2-s COD is punishing changeovers), it should also have been punishing changeovers in Experiment 1. Therefore, even though there was no overmatching in the post-COD data in Experiment 1, this model was also fitted to those data (Table 2.6).

Table 2.6
Estimates of relative discriminability ($p_r$), discriminability ($d_r$), bias (log c), punishment (w), and the percentage of variance accounted for (%VAC) for the lines of best fit for post-COD responding from Experiment 1.

| C-D Model | | | | |
|---|---|---|---|---|
| Possum | $p_r$ | $d_r$ | log $c$ | %VAC |
| George | 0.93 | 12.41 | -0.09 | 98.80 |
| Arthur | 0.81 | 4.22 | -0.02 | 93.45 |
| Timmy | 0.94 | 15.56 | 0.07 | 98.52 |
| Holly | 0.95 | 17.26 | -0.01 | 98.54 |
| Sylvester | 1.00 | -220.94 | -0.09 | 98.53 |
| MEAN | 0.93 | -34.30 | -0.03 | 97.57 |

| Punishment Version | | | | | |
|---|---|---|---|---|---|
| | $p_r$ | $d_r$ | log $c$ | w | %VAC |
| George | 4495.25 | -1.00 | -0.08 | -1936254.17 | 98.97 |
| Arthur | 0.81 | 4.22 | -0.02 | 0.00 | 93.45 |
| Timmy | 1.14 | -8.16 | 0.11 | -65.72 | 98.99 |
| Holly | 0.64 | 1.77 | -0.07 | 73.91 | 99.41 |
| Sylvester | 0.80 | 4.01 | -0.16 | 56.89 | 99.70 |
| MEAN | 899.73 | 0.17 | -0.04 | -387237.82 | 98.10 |

| Punishment Version (Constrained) | | | | | |
|---|---|---|---|---|---|
| | $p_r$ | $d_r$ | log $c$ | w | %VAC |
| George | 0.93 | 12.42 | -0.09 | -0.01 | 98.82 |
| Arthur | | | | | |
| Timmy | 1.00 | infinity | 0.09 | -20.70 | 98.82 |
| Holly | | | | | |
| Sylvester | | | | | |

For 2 subjects in Experiment 1, the addition of $w$ did result in a reduction in the value of $p_r$. However, the values of $w$ obtained (56.89 and 73.91 reinforcers per minute) were extremely large compared to those reported by Davison and McCarthy (ranging from 0.02 to 0.243). These values suggest that, when these subjects changed from responding on one lever to responding on the other, the perceived loss of reinforcers was greater than 50 per minute. While this may at first appear highly unlikely, when considered in terms of the actual length of the COD, which in this case was 2 s, the 'perceived' loss of reinforcers each time a changeover response was made was 1.9 and 2.5 for these subjects (Sylvester and Holly respectively). When viewed in this way, the model appears to provide a slightly more reasonable description of the effects on these subjects' behaviour when a COD is introduced, although the 'perceived cost of each changeover' still appears to be quite high.

In two cases (George and Timmy) when Davison and McCarthy's punishment model was used with the post-COD data from Experiment 1, the value of $p_r$ obtained became greater than 1.0. In these cases, the value of $w$ was negative, with the subjects apparently perceiving a gain of 2.19 and 64,500 reinforcers per changeover. While the perceived gain of 64,500 reinforcers per changeover indicates that the model has failed here, the increase in the value of $p_r$ for these subjects is also of concern because Davison and McCarthy introduced $w$ to enable the model to account for data which show overmatching by reducing $p_r$. Davison and McCarthy's (1994) results showed three cases where values of $p_r$ were greater than 1.0 (1.05-1.06), however they stated that these values were not *significantly* greater than 1.0, and therefore were of no concern (although no mention was made of how this was tested). However, in Experiment 1, a $p_r$ value of greater than 4000 was obtained, which is quite likely to be significantly greater than 1.0. It is possible that the problems encountered in Experiment 1 are due to the lack of overmatching in the data. Davison (personal communication) suggested that the punishment model should be applied only when a value of $p_r$ greater than 1.0 is obtained with the original model, which was not the case for any subject's post-COD data in Experiment 1.

If the COD was, in fact, punishing changeovers in the present experiment, it would be expected that *w* (reinforcers lost per minute due to changing over) would increase with increases in COD length. This was not the case. The obtained values of *w* ranged from –809,132 (Jasper, 2-s COD) to 144 (Jasper, 4-s COD). A negative value of *w* presumably implies that the subject perceived that reinforcers were gained by changing over (in this case 13,485 during every second spent in the COD).

The values of $p_r$ when the punishment model was fitted were also of concern. There were still several cases in which the value of $p_r$ was greater than 1.0 (10 cases compared with 9 with the original C-D model). In a personal correspondence, Davison suggested that, in such cases, the value of $p_r$ should be constrained in the estimation process to be less than or equal to 1.0. This is presumably because these values are only greater than 1.0 due to statistical error. However, Davison and McCarthy stated that if any of the estimates of $p_r$ were significantly greater than 1.0, this would indicate that the model had failed. The right-hand side of Table 2.5 gives the results when the punishment model was fitted to the data from the present experiment with $p_r$ constrained to be less than or equal to 1.0. The values of *w* obtained were still negative in five cases, with values ranging from –809,132 to 18.46. These data suggest that the punishment version of the C-D model does not provide a good description of post-COD response allocation, and could not be used to predict behaviour under such schedules, at least for possums. It should be noted that, in several cases, the degree of overmatching in the present experiment may not have been considered large enough to justify the use of the punishment version of the C-D model. As mentioned previously, Baum (1979) suggested that *a* values in the range 0.9 to 1.11 are not significantly different from 1.0. In the present experiment, the *a* value was only larger than 1.11 in 7 of 15 cases, and was only consistently larger than 1.11 for 1 subject (Benny). Davison might argue that in those cases where *a* may not have been significantly greater than 1.0, this model is not appropriate. The implications of this will be discussed later. However, it should be noted that the parameters obtained from fitting this equation to Benny's data (with *a* values

which are presumably significantly greater than 1.0) are no less problematic than those obtained with other subjects' data.

The C-D model assumes that any deviations from matching found with a GML analysis are the result of less than perfect discriminability (Davison & Jenkins, 1985). However, the degree of deviation often differs for response and time measures of behaviour. While response measures are more commonly used in C-D analyses, there is no evidence to suggest that response measures are more appropriate for describing behaviour than time measures. It is possible that time-allocation data provide the better measure of discriminability. If this is the case, the problems observed when fitting the punishment version of the C-D model to post-COD response data may not appear when post-COD time data are used instead.

The GML, the original C-D model and the punishment version of the C-D model were fitted to the post-COD time-allocation data from the present experiment (Tables 2.7 and 2.8). The value of $a$ does not increase with increases in COD length. When the C-D model was fitted to the post-COD time data, $p_r$ values greater than 1.0 were obtained in most cases, suggesting that it is appropriate to use the punishment version of the C-D model with these data. When fitted, $p_r$ becomes less than 1.0 in several cases (7 of 13). When the model was fitted to the 6-s COD data, $p_r$ remained (or became) greater than 1.0 in all cases (ranging from 1.03 to 7547.23). For the 4 subjects that completed all three sets of conditions, values of $w$ decreased with increases in COD length for 2 subjects, while for the other 2 subjects there were no consistent changes in $w$ with increases in COD length. The parameter $w$ was negative in several cases (always when $p_r$ was greater than 1.0). When $p_r$ was constrained to be less than or equal to 1.0, values of $w$ were positive in all but one case, however, there were still no consistent changes in values of $w$ with changes in COD length.

The above analysis suggests that the punishment version of the C-D model is no better suited to the analysis of post-COD time data than it is to post-COD response data. This suggests that either the COD does not have a punishing effect on changeover behaviour, or that this punishment operates in a manner that

Table 2.7
The paramater estimates obtained when the GML was fitted to the post-COD time data from the 2-s, 4-s and 6-s COD conditions.

| | *a* | log *c* | SE | %VAC |
|---|---|---|---|---|
| | | 2-s COD | | |
| Static | 1.24 | 0.00 | 0.07 | 99.6 |
| Jasper | 1.03 | 0.00 | 0.14 | 97.2 |
| Izzie | 1.04 | 0.05 | 0.07 | 99.4 |
| Benny | 1.05 | -0.05 | 0.04 | 99.7 |
| Emma | 0.99 | -0.03 | 0.10 | 98.4 |
| Putzy | | | | |
| Mean | 1.07 | -0.01 | 0.08 | 98.9 |
| | | 4-s COD | | |
| Static | 1.21 | -0.03 | 0.10 | 98.9 |
| Jasper | 1.08 | -0.11 | 0.03 | 99.9 |
| Izzie | | | | |
| Benny | 1.07 | -0.01 | 0.04 | 99.8 |
| Emma | 1.03 | -0.09 | 0.08 | 98.9 |
| Putzy | | | | |
| Mean | 1.10 | -0.06 | 0.06 | 99.4 |
| | | 6-s COD | | |
| Static | 1.31 | -0.10 | 0.15 | 98.5 |
| Jasper | 0.88 | -0.04 | 0.06 | 99.4 |
| Izzie | | | | |
| Benny | 1.03 | 0.03 | 0.07 | 99.4 |
| Emma | 1.06 | -0.12 | 0.10 | 99.0 |
| Putzy | 1.10 | 0.17 | 0.34 | 89.2 |
| Mean | 1.08 | -0.01 | 0.14 | 97.1 |

Table 2.8

Estimates of relative discriminability ($p_r$), discriminability ($d_r$), bias (log $c$), punishment ($w$), and the percentage of variance accounted for (%VAC) for the lines of best fit for the post-COD time data. Estimates were obtained using the original C-D model, and the punishment version (with and without $p_r$ constrained).

| | $p_r$ | $d_r$ | log $c$ | %VAC | $p_r$ | $d_r$ | log $c$ | $w$ | %VAC | $p_r$ | $d_r$ | log $c$ | $w$ | %VAC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 2-s COD | | | | | | | |
| Static | 1.05 | -21.00 | 0.00 | 99.2 | 0.86 | 6.14 | 0.00 | 59.09 | 99.6 | | | | | |
| Jasper | 1.01 | -101.00 | 0.00 | 97.2 | 1.01 | -101.00 | 0.00 | -0.01 | 97.2 | 1.00 | infinity | 0.00 | 3.21 | 97.2 |
| Izzie | 1.01 | -101.00 | 0.06 | 99.3 | 0.84 | 5.25 | 0.07 | 49.24 | 99.8 | | | | | |
| Benny | 1.01 | -101.00 | -0.05 | 99.7 | 0.95 | 19.00 | -0.03 | 14.86 | 99.9 | | | | | |
| Emma | 1.00 | infinity | -0.03 | 98.4 | 0.92 | 11.50 | -0.02 | 25.76 | 98.5 | | | | | |
| Putzy | | | | | | | | | | | | | | |
| Mean | 1.02 | -81.00 | 0.00 | 98.8 | 0.92 | -11.82 | 0.00 | 29.79 | 99.0 | | | | | |
| | | | | | | | 4-s COD | | | | | | | |
| Static | 1.04 | -26.00 | -0.03 | 98.5 | 0.92 | 11.50 | -0.04 | 35.92 | 98.6 | | | | | |
| Jasper | 1.02 | -51.00 | -0.11 | 99.9 | 0.78 | 3.55 | -0.11 | 88.22 | 100.0 | | | | | |
| Izzie | | | | | | | | | | | | | | |
| Benny | 1.02 | -51.00 | -0.01 | 99.8 | 1.06 | -17.67 | -0.01 | -9.77 | 99.8 | 1.00 | infinity | -0.01 | 3.93 | 99.8 |
| Emma | 1.01 | -101.00 | -0.09 | 98.9 | 0.91 | 10.11 | -0.09 | 32.16 | 99.4 | | | | | |
| Putzy | | | | | | | | | | | | | | |
| Mean | 1.02 | -57.25 | -0.06 | 99.3 | 0.92 | 1.87 | -0.06 | 36.63 | 99.4 | | | | | |
| | | | | | | | 6-s COD | | | | | | | |
| Static | 1.05 | -21.00 | -0.09 | 97.7 | 1.14 | -8.14 | -0.13 | -21.10 | 98.0 | 1.00 | infinity | -0.07 | 12.00 | 97.1 |
| Jasper | 0.97 | 32.33 | -0.04 | 99.2 | 7547.23 | -1.00 | -0.03 | -2530162.16 | 99.9 | 1.00 | infinity | -0.04 | -11.82 | 99.3 |
| Izzie | | | | | | | | | | | | | | |
| Benny | 1.01 | -101.00 | 0.03 | 99.4 | 1.20 | -6.00 | 0.06 | -46.02 | 99.5 | 1.00 | infinity | 0.02 | 1.70 | 99.4 |
| Emma | 1.02 | -51.00 | -0.12 | 99.2 | 1.03 | -34.33 | -0.12 | -4.51 | 99.2 | 1.00 | infinity | -0.12 | 5.68 | 99.2 |
| Putzy | 1.02 | -51.00 | 0.07 | 88.9 | 1.33 | -4.03 | 0.15 | -76.69 | 89.0 | 1.00 | infinity | 0.17 | 4.89 | 88.9 |
| Mean | 1.01 | -38.33 | -0.03 | 96.9 | 1510.39 | -10.70 | -0.01 | -506062.10 | 97.1 | | | | | |

is not captured by this version of the C-D model.

Two problems are evident with Davison's proposed rules for using the punishment version of the C-D model. The problems lie in the application of the two forms of the C-D model, with and without the punishment term, and the effects of the COD. Generally, increasing the length of the COD increases sensitivity to reinforcement using GML analyses, up to a point. For data which lie on or below matching, this increase in sensitivity (towards matching) is interpreted as being the result of the COD increasing discriminability. Once data overmatch, the C-D model cannot (in its simple form) describe response ratios that are more extreme than the reinforcer-rate ratios. The punishment term, by subtracting equal numbers of reinforcers from both the numerator and the denominator, allows the model to describe more extreme behaviour, and has a degree of logical appeal. A period in which reinforcement is never delivered can be easily argued to be subtracting from the overall 'value' of each schedule. The problem arises in the logic of the application. To argue (as Davison has, personal communication) that the punishment term should be included only in cases where the data require it (i.e., when overmatching was found) seems a little circular. There should be, at least, some argument to support the notion that a COD of a particular length might mark the transition from discrimination enhancement to punishment of changing over.

The second problem comes from constraining $p_r$ to be less than 1.0, which is the same as constraining $d_r$ to lie between 1 and $\infty$. Unfortunately, when the data from the present experiment were fitted without constraining $p_r$, values outside the range 0.5 to 1.0 were obtained, and $d_r$ was negative. Logically, this makes no sense in terms of the original assumptions of the model. To counteract this, Davison (personal communication) has suggested constraining $p_r$ to be less than 1.0, but this simply forces the equation to produce larger values of $w$ (the punishment term) to fit the data.

Extinction

Davison and Jenkins (1985) stated that the C-D model provides a better

description of behaviour on concurrent VI EXT schedules of reinforcement. As noted in the General Introduction, the GML always predicts exclusive responding on the VI alternative, whereas the C-D model predicts that the behaviour ratio will equal $cd_r$ (Equation 0.5). While the data from the concurrent EXT VI schedule in the present experiment did not give exclusive responding to the VI alternative, the proportion of responses and time spent on the extinction alternative was much less than that predicted by the C-D model. When post-COD data were considered, the proportion of responses made to the VI alternative was reasonably close to that predicted by the C-D model, however, this was close to 1.0 in all cases (which is the proportion predicted by the GML). These data suggest that the majority of the responses made to the extinction alternative occur during the COD, which, as it has been shown previously, is discriminated by the subjects, with insensitive responding found during this period. It is quite likely that the few responses which occurred outside the COD on the extinction schedule occurred very close to the end of the COD. It has been shown in this experiment that the response rate during the COD was higher than at any other time, and that this rate rapidly dropped off following the end of the COD. This would also be consistent with Silberberg and Fantino's (1970) finding that almost all post-COD responding on the lean alternative results from the continuation of the COD burst. Several other studies have reported responding on an extinction schedule (Davison & Hunter, 1976; Davison & Jones, 1998; Herrnstein, 1961; Hollard & Davison, 1971; Stubbs & Pliskoff, 1969). In all of these cases, the numbers of responses were small and all of the studies used a COD of at least 1.5 s. It is possible that in these cases, as in the present experiment, the majority of these responses occurred during the COD (again, with the remaining responses likely to be occurring just after the end of the COD).

It appears that the undermatching found in Experiment 1 was not due to an insufficient COD length. A similar amount of response undermatching was observed in the present study. However, the post-COD response-allocation data in the present experiment were similar to those observed with other species. It is unclear why this was not the case in Experiment 1. Given the stability of the *a*

values, and the similarity of post-COD response sensitivity and time-allocation sensitivity to that found in previous studies, it is unlikely that further increases in the length of the COD would result in increased sensitivity to reinforcement.

The C-D model and the GML provided equally good descriptions of behaviour in the present study. However, the punishment version of the C-D model was shown to be unsuitable for describing both post-COD response- and time-allocation data from possums. It remains to be seen how the C-D model deals with experimentally introduced biasers.

# EXPERIMENT 3

Experiment 1 demonstrated that possums respond similarly to other species on concurrent VI VI schedules of reinforcement, although larger degrees of undermatching were observed with their response measures than those typically observed for other species. Despite this, the possums' response- and time-allocation measures were well described by both the GML and Davison and Jenkins' (1985) C-D model. This suggests that concurrent VI VI schedules of reinforcement are an appropriate method for studying the choice behaviour of the possum.

Of particular interest here was the study of possums' food preferences. The food preferences of other species have been studied using concurrent VI VI schedules of reinforcement by providing different feeds as reinforcers for responses on each of the alternatives and by varying the reinforcer-rate ratio (Foster et al., 1996; Matthews & Temple, 1979; Miller, 1976). The data obtained from these experiments can be analysed using a modification of the GML (Equation 0.2). This equation was presented slightly differently by Davison and McCarthy (1988):

$$\text{Log}\,(B_1/B_2) = a \log (r_1/r_2) + q \log (Q_1/Q_2) + \log b \qquad (3.1)$$

where $q$ is a measure of quality sensitivity (i.e., sensitivity to quantitative changes in the quality ratio), $Q_1$ and $Q_2$ are the qualities of the two foods, and log $b$ is inherent bias (log $c$ in Equations 0.1 and 0.2).

Davison and McCarthy (1988) suggested that it would be possible to obtain point estimates of bias by presenting two different food reinforcers on equal concurrent VI VI schedules of reinforcement (i.e., log $(r_1/r_2) = 0$), and then swapping the response alternative that each is associated with. This requires only two conditions. The behaviour in these conditions would be described by the following equations:

$$\text{Log}\,(B_1/B_2) = q \log (Q_1/Q_2) + \log b \qquad (3.2)$$

$$\text{Log } (B_3/B_4) = q \log (Q_2/Q_1) + \log b \quad (3.3)$$

where $B_3$ and $B_4$ represent responses or times allocated to the left and right manipulanda respectively after the side of food presentation has been swapped. Subtracting Equation 3.3 from Equation 3.2 would therefore give a measure of the relative quality of the foods:

$$0.5 \log (B_1.B_4/B_2.B_3) = q \log (Q_1/Q_2) \quad (3.4)$$

Note that this measure of bias does not include inherent bias (log $b$), since this was assumed to be constant and equal in both conditions, and is therefore removed in the subtraction. Taking the antilogarithm of the above bias measure ($q$ log $(Q_1/Q_2)$) gives a ratio of the bias towards $Q_1$ (e.g., Miller, 1976).

The aim of the present experiment was to determine whether the behaviour of possums under concurrent schedules of reinforcement could be biased using qualitatively different reinforcers. The method outlined above (i.e., point estimates) was used, to determine the biases resulting from different feeds.

## Method

### Subjects

The same 5 possums were used in this experiment as in Experiment 1.

### Apparatus

The experimental equipment was almost identical to that used in Experiment 1. The only difference was that the magazine was removed from the centre of the cage door, and replaced with two magazines, one located under the left and the other under the right response lever. Access to these magazines was through two holes (130 mm by 100 mm) in the cage door 180 mm below each of the response levers. Each magazine provided reinforcement only for responses on the lever it was located below. The reinforcers used in the present experiment were barley/carob mixture (as in Experiment 1), Cocopops ™ (breakfast cereal consisting of puffed rice covered with cocoa), and desiccated coconut.

Procedure

Condition 1 involved the presentation of a mixture of steam-flaked barley and carob chips in a ratio of 15:1 (standard reinforcer) in both magazines on a concurrent VI 40-s VI 40-s schedule. Conditions 2 and 3 involved presenting Cocopops in the left and the right magazine respectively, with the standard reinforcer in the other magazine. In Condition 4, coconut was presented in the right magazine, while the left magazine contained the standard reinforcer. Condition 5 was a reversal of Condition 4, with coconut in the left magazine. The order of conditions and the number of sessions required for each condition are presented in Table 3.1. For each subject, Conditions 1-3 were changed as soon as their behaviour reached the same stability criteria described in Experiment 1. In Conditions 4 and 5, stability was assessed graphically only, by two or more people (as previously described) as it was found in the previous conditions that subjects' behaviour changed quickly when the side the foods were presented on was changed, and remained stable. All data recorded were the same as for Experiment 1.

## Results

The raw data from the last five sessions of Conditions 1 to 5 are presented in Appendix C. All analyses were carried out on the data from the last five sessions of each condition. All ratios were taken to the left manipulandum and all logarithms are to the base 10. The bias measures were calculated using Equation 3.4 such that a value greater than 1.0 indicates a bias towards the barley/carob mixture. The biases obtained in the Cocopops vs. barley conditions were calculated using the total number of responses or total time allocated to each lever during the last five sessions of Conditions 2 (barley:Cocopops) and 3 (Cocopops:barley), such that $B_1$ and $B_2$ were the total amounts of behaviour allocated to the left (barley) and right (Cocopops) levers respectively during Condition 2, and $B_3$ and $B_4$ were the total amounts of behaviour allocated to the left (Cocopops) and right (barley) levers respectively during Condition 3. The

Table 3.1
The order of conditions for Experiment 3, the foods presented in the left and right magazines, and the number of sessions required to reach stability in each condition.

| Condition | Left Magazine | Right Magazine | No of Sessions |
|---|---|---|---|
| 1 | Barley | Barley | 14-27 |
| 2 | Barley | Cocopops | 16-37 |
| 3 | Cocopops | Barley | 14-20 |
| 4 | Coconut | Barley | 10-20 |
| 5 | Barley | Coconut | 13-22 |

biases obtained in the coconut vs. barley conditions were calculated using the total number of responses or total time allocated to each lever during the last five sessions of Conditions 4 (coconut:barley) and 5 (barley:coconut), such that $B_1$ and $B_2$ were the total amounts of behaviour allocated to the right (barley) and left (coconut) levers respectively during Condition 4, and $B_3$ and $B_4$ were the total amounts of behaviour allocated to the right (coconut) and left (barley) levers respectively during Condition 5.

Bias Estimates

Figure 3.1 shows the logarithms of the ratios of the numbers of responses allocated to each lever plotted across each of the last five sessions of each condition. The condition headings show the reinforcer presented in the left magazine, followed by the reinforcer presented in the right magazine. The dotted lines on each graph represent the bias measured during the barley vs. barley condition (i.e., inherent bias). This was obtained by taking the logarithms of the ratios of all responses made to each lever during the last five sessions of Condition 1 for each possum. In Condition 1, with the standard reinforcer (barley/carob mixture) in both magazines, the data for all but 1 subject (the exception being Arthur, whose data showed no apparent bias) generally exhibited small biases to the left lever (indicated by a log response ratio greater than 0). These results are consistent with those found in Experiment 1 where barley/carob mixture was presented for responding on both levers via a single magazine. During the two conditions where Cocopops were presented (Conditions 2 and 3), there were small response biases for all subjects. Two subjects showed consistent biases towards Cocopops during these conditions (George and Holly), while 2 subjects' response biases were towards the left lever in both conditions (Arthur and Sylvester). The remaining subject's (Timmy) response bias was towards Cocopops during Condition 2, with no apparent response bias in Condition 3.

When coconut was presented (Conditions 4 and 5), 3 subjects' response biases were consistently towards barley. The remaining subjects' (Arthur and Timmy) data showed no bias in Condition 4, but did towards barley in Condition

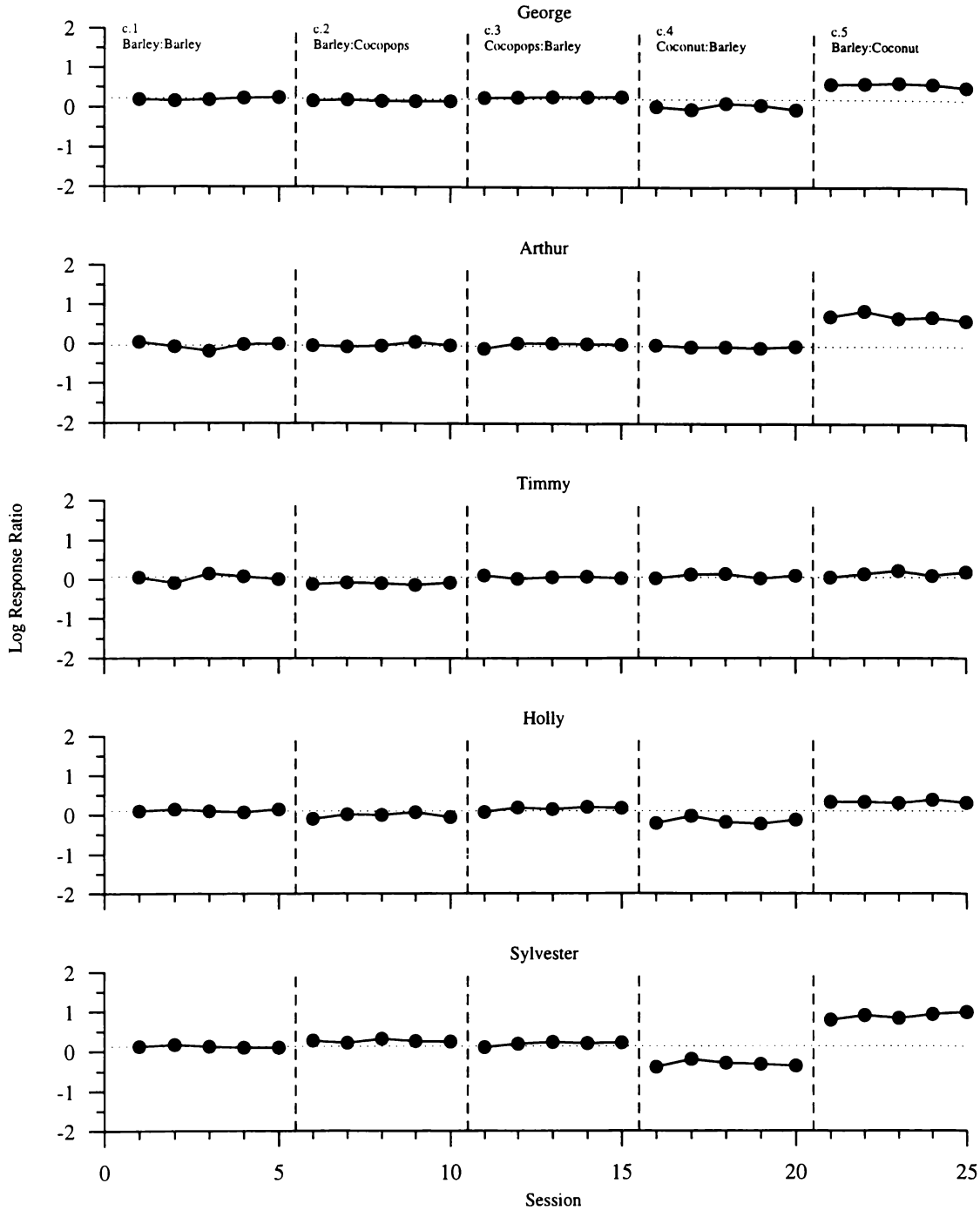


Figure 3.1. The logarithms of the response ratios plotted for each of the last five sessions of each condition.

5. It can be seen from this figure that, for 3 of the 5 subjects (the exceptions being Timmy and Arthur), the degree of bias was greater when coconut was presented than when Cocopops were presented. This is more obvious in the second Coconut Condition (Condition 5).

Overall response biases from the conditions with Cocopops and coconut were calculated as described earlier. These biases are presented in Table 3.2. The response biases shown for the barley vs. barley condition are the values of intercepts of the dotted lines presented in Figure 3.1, and represent inherent bias. The values presented for the Cocopops and Coconut Conditions represent the degree of overall bias towards the barley/carob mixture calculated using Equation 3.4, as described previously (note that because each food was presented on both sides, inherent bias is not included in these values). Therefore, an overall response bias value of 0.88 (obtained by George with Cocopops) indicates that, under these conditions, George's barley:Cocopops response bias was 0.88:1.0 (which indicates a bias towards Cocopops). Only 1 possum's (Sylvester) overall response bias was towards the barley/carob mixture (by a ratio of 1.09:1.0) when Cocopops were presented. When coconut was presented (Conditions 4 and 5), all subjects showed overall response biases towards the barley/carob mixture (ranging from 1.08 - 4.04:1.0). The size of the bias calculated from the Cocopops conditions was smaller than the inherent bias (barley vs. barley) for all subjects except Timmy, indicating indifference between these two foods. The size of the bias calculated from the coconut conditions was larger than the inherent bias for all subjects except Timmy.

Figure 3.2 shows the logarithms of the time-allocation ratios plotted across the last five sessions of each condition for each possum. Again, the dotted lines show the biases measured during Condition 1 where barley was presented in both magazines (i.e., inherent biases), calculated in the same way as for the response-allocation data. Generally, the time biases obtained in Condition 1 (barley:barley) are similar to those found in Experiment 1 (two levers, one magazine). The biases were small in both cases, and for all but 1 subject (George) they were in the same direction (towards the left lever for 3 subjects, and the right

Table 3.2
Point estimates of the ratio of bias for each subject towards the preferred alternative when Barley/Carob mixture was paired with Cocopops and Coconut. Bias towards the Barley/Carob mixture is indicated by a value greater than 1.0.

| Possum | Barley | Cocopops | Coconut | Barley | Cocopops | Coconut |
|---|---|---|---|---|---|---|
| | | Responses | | | Time | |
| George | 1.66 | 0.88 | 1.98 | 1.12 | 0.95 | 3.21 |
| Arthur | 0.89 | 0.98 | 2.41 | 1.26 | 0.96 | 2.95 |
| Timmy | 1.17 | 0.83 | 1.08 | 1.05 | 0.97 | 1.16 |
| Holly | 1.29 | 0.83 | 1.72 | 1.26 | 1.15 | 1.96 |
| Sylvester | 1.35 | 1.09 | 4.04 | 0.83 | 1.31 | 5.38 |
| MEAN | 1.27 | 0.92 | 2.25 | 1.10 | 1.07 | 2.93 |
| | | Within COD | | | Post COD | |
| George | 2.51 | 0.94 | 0.94 | 1.07 | 0.86 | 3.87 |
| Arthur | 0.91 | 1.01 | 1.22 | 0.89 | 0.96 | 3.66 |
| Timmy | 0.69 | 0.96 | 1.02 | 2.14 | 0.71 | 1.09 |
| Holly | 1.35 | 0.92 | 0.89 | 1.26 | 0.77 | 2.93 |
| Sylvester | 1.86 | 0.88 | 1.08 | 0.89 | 1.36 | 12.10 |
| MEAN | 1.46 | 0.94 | 1.03 | 1.25 | 0.93 | 4.73 |
| | | PRP Time | | | Net Time | |
| George | 1.12 | 1.14 | 2.06 | 1.12 | 0.86 | 3.97 |
| Arthur | 1.20 | 1.57 | 2.92 | 1.29 | 0.78 | 2.89 |
| Timmy | 0.83 | 1.61 | 1.21 | 1.74 | 0.59 | 1.09 |
| Holly | 1.26 | 1.74 | 1.71 | 1.29 | 0.72 | 2.26 |
| Sylvester | 1.07 | 2.41 | 3.61 | 0.69 | 1.03 | 6.40 |
| MEAN | 1.10 | 1.69 | 2.30 | 1.23 | 0.80 | 3.32 |
| | | First Half Responses | | | Second Half Responses | |
| George | 1.58 | 0.85 | 1.78 | 1.74 | 0.94 | 2.49 |
| Arthur | 0.91 | 0.97 | 2.28 | 0.87 | 1.00 | 2.60 |
| Timmy | 1.10 | 0.82 | 1.11 | 1.26 | 0.84 | 1.04 |
| Holly | 1.17 | 0.83 | 1.62 | 1.45 | 0.84 | 1.92 |
| Sylvester | 1.35 | 1.14 | 3.77 | 1.35 | 1.02 | 5.03 |
| MEAN | 1.22 | 0.92 | 2.11 | 1.33 | 0.93 | 2.62 |
| | | First Half Time | | | Second Half Time | |
| George | 1.17 | 0.91 | 2.80 | 1.10 | 0.99 | 3.75 |
| Arthur | 1.26 | 0.97 | 2.84 | 1.26 | 0.96 | 3.08 |
| Timmy | 1.12 | 0.95 | 1.25 | 0.98 | 1.00 | 1.06 |
| Holly | 1.29 | 1.15 | 2.24 | 1.23 | 1.16 | 1.73 |
| Sylvester | 0.89 | 1.45 | 4.89 | 0.78 | 1.19 | 6.14 |
| MEAN | 1.15 | 1.09 | 2.80 | 1.07 | 1.06 | 3.15 |

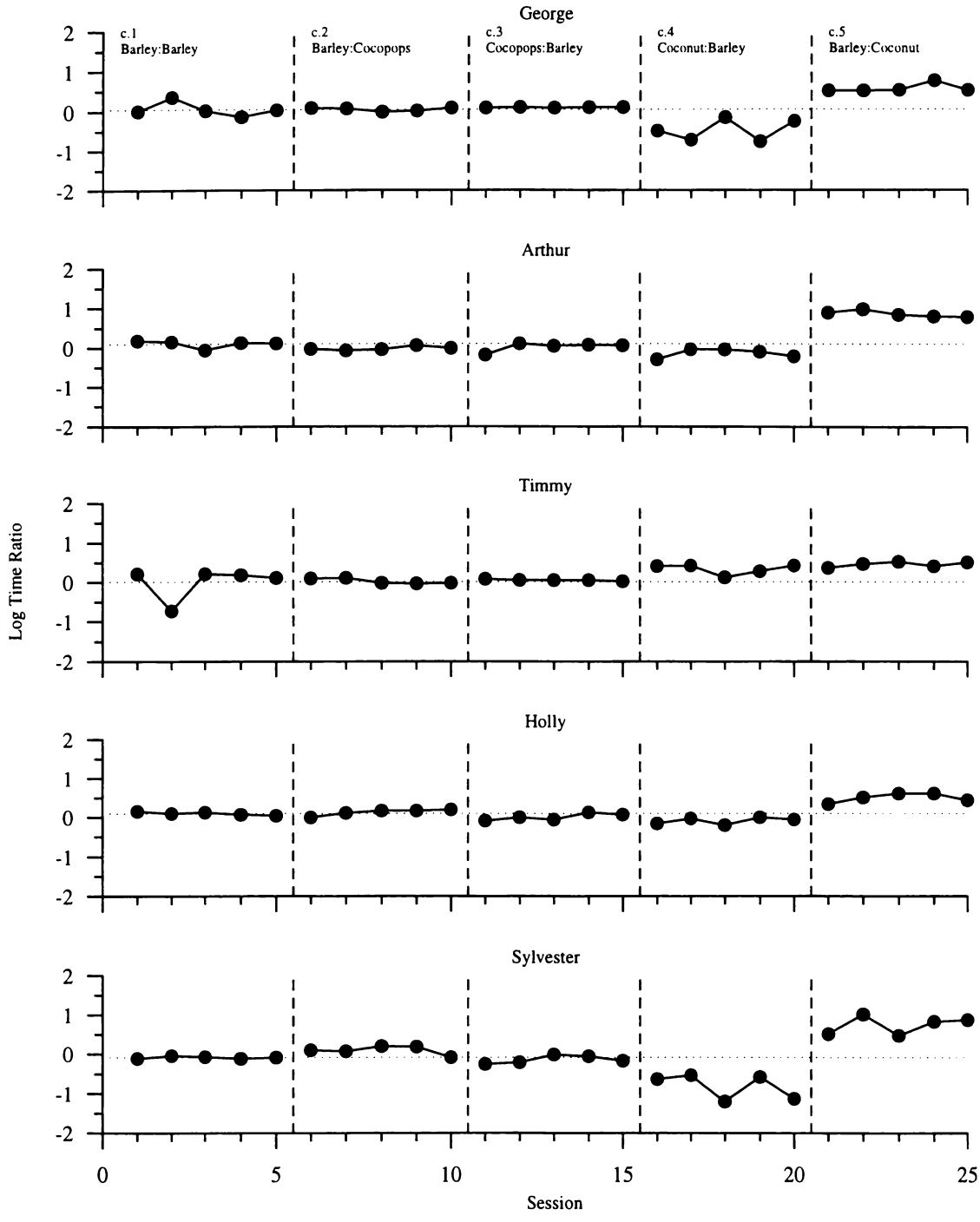


Figure 3.2. The logarithms of the time-allocation ratios plotted for each of the last five sessions of each condition.

lever for 1 subject). The time-allocation data tended to be more variable across the last five sessions than the response-allocation data. For all but 2 subjects (Arthur and Sylvester), the response and time biases observed during Condition 1 were in the same direction. All of the time biases obtained during the Cocopops conditions (Conditions 2 and 3) were very small. During these conditions, 2 subjects' (Holly and Sylvester) time biases were consistently towards barley, while there was no apparent time bias for Timmy in either condition. There was no time bias in George's data in Condition 2 and it was small in Condition 3, while Arthur's time-allocation was biased to the right in both conditions (i.e., towards Cocopops in Condition 2 and barley in Condition 3). When coconut was presented, the time biases for all subjects, except Timmy, were towards barley. For Timmy, bias was towards the left lever during both Conditions 4 and 5. Generally, time biases were larger in the coconut conditions than in the Cocopops conditions, as was the case with response allocation.

The time-allocation biases, calculated using Equation 3.4 as described previously, are presented in Table 3.2. When Cocopops were presented, 3 subjects' overall time biases were slightly towards Cocopops, while the other 2 (Holly and Sylvester) showed overall time biases towards barley. In all but one case (Arthur in the Cocopops conditions), the overall time biases were larger than the overall response biases (i.e., although the time biases themselves may not have been larger, the time biases were more towards barley than the response biases). When Cocopops were presented, the overall time-allocation biases ranged from 0.95 to 1.31. When coconut was presented, all subjects' overall time-allocation biases were towards barley (ranging from 1.16 - 5.38:1.0). Similar to the overall response-allocation biases, the sizes of the overall time-allocation biases calculated for the Cocopops conditions were smaller than the barley vs. barley biases for all subjects except Sylvester, again indicating indifference between Cocopops and barley. The size of the overall time bias calculated from the coconut conditions was larger than the barley vs. barley bias for all subjects.

The logarithms of the ratios of the numbers of responses made within (filled circles) and after (unfilled circles) the COD are plotted against the last five

sessions of each condition in Figure 3.3. The dotted lines presented on each graph represent the average inherent biases observed within the COD, while the dashed lines represent the inherent biases from after the COD (calculated as for responses and time). It can be seen that the data from within the COD do not vary much from condition to condition; thus any biases observed in the total response data were the result of post-COD biases. The post-COD biases were more variable across conditions.

When barley was presented in both magazines, the post-COD log response ratios were very close to zero for all subjects, except Timmy (towards the left). Very small biases towards the left lever were observed in the post-COD data from George and Holly, and very small right biases were observed for Sylvester and Arthur. Within-COD responding during Condition 1 was biased towards the left for 3 subjects and slightly towards the right for two (Timmy and Arthur). The post-COD biases during the Cocopops conditions (Conditions 2 and 3) were small for all subjects. When Cocopops were presented, only 1 subject's (Holly) post-COD responding was clearly biased towards Cocopops. One subject's (Timmy) post-COD responding was biased towards the right in both Cocopops conditions. Both George and Arthur showed no post-COD biases in Condition 2 with post-COD biases towards Cocopops in Condition 3, while there was a bias towards barley for Sylvester in Condition 2 and no bias in Condition 3. All but 1 subject (the exception being Timmy) showed large post-COD biases towards barley when coconut was presented (Conditions 4 and 5). Timmy's post-COD response bias was to the left in both coconut conditions (i.e., towards coconut in Condition 4 and barley in Condition 5).

The within- and post-COD biases, calculated from Equation 3.4 as previously described, are presented in Table 3.2. In all cases, when barley was presented in both magazines, the within-COD biases were in the same direction and of similar magnitude to those observed in Experiment 1, while the post-COD biases were in the opposite direction for 2 subjects (George and Holly). The within-COD inherent biases were larger than the overall within-COD Cocopops and coconut biases in all cases but one (Arthur, when coconut was presented).

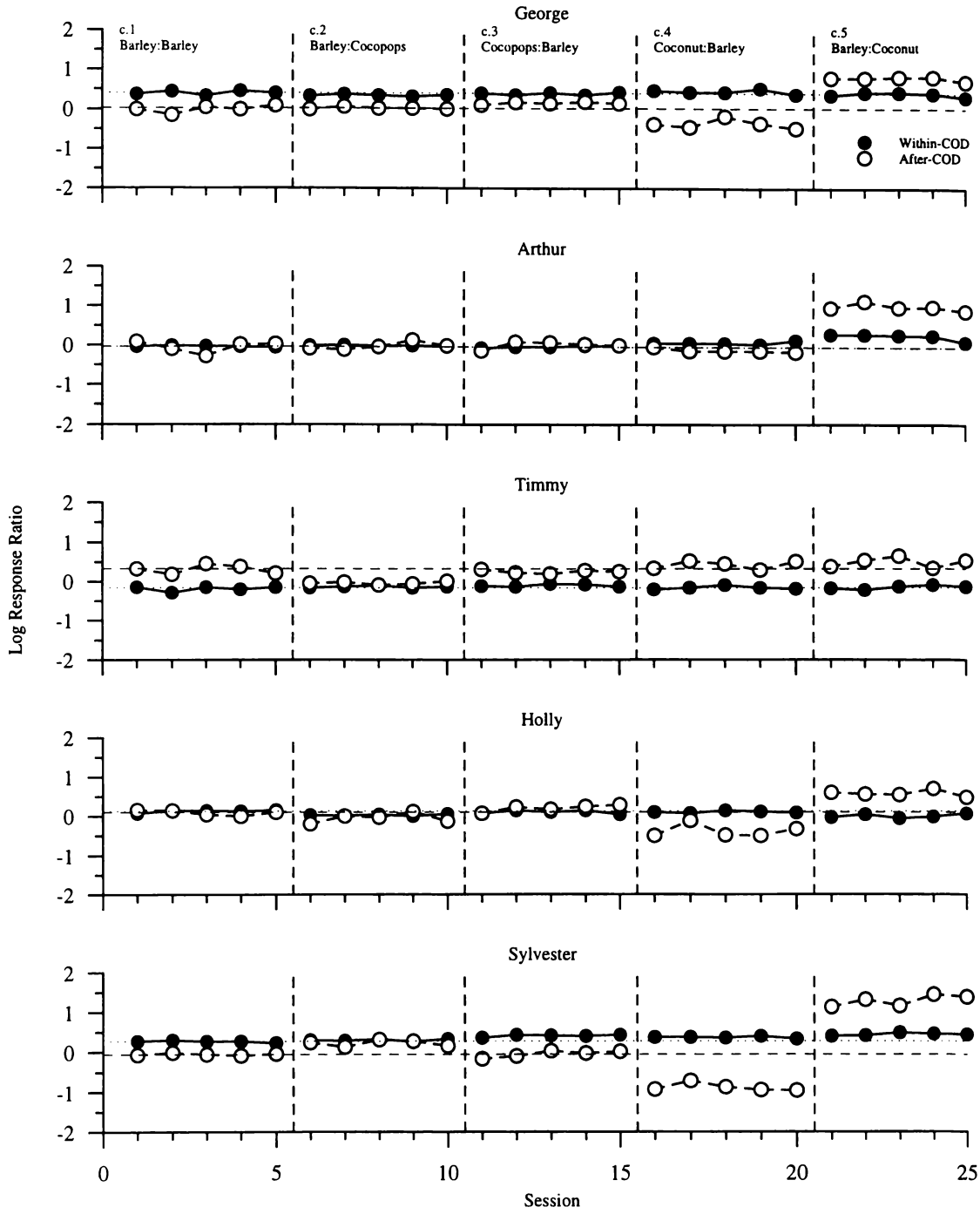


Figure 3.3. The logarithms of the response ratios from both within and after the changeover delay plotted for each of the last five sessions from each condition.

The post-COD inherent biases were smaller than the overall post-COD Cocopops and coconut biases in most cases (the exceptions were Arthur when Cocopops were presented, and Timmy when both Cocopops and coconut were presented). In all cases, the overall within-COD biases from the Cocopops and Coconut Conditions (0.88-1.01 and 0.89-1.22 respectively) were smaller (i.e., closer to 1.0) than the overall total response biases (0.71-1.36 for Cocopops and 1.09-12.10 for coconut). As a result, the overall post-COD response biases were more extreme than the overall total response biases for both Cocopops and Coconut Conditions, although both measures were in the same direction. This was not the case for the barley vs. barley condition, where the biases within the COD were smaller than the post-COD biases for only 2 subjects (Arthur and Timmy).

In Figure 3.4, the logarithms of the response ratios are plotted for the first (filled circles) and second halves (unfilled circles) of the session across the last five sessions of each condition for each possum. In those cases where the first and second half data were similar, only the unfilled circle is fully visible. The dotted and dashed lines presented on each graph represent the inherent biases during the first and second half of the session respectively. This was calculated from Condition 1 (barley vs. barley) as for total responses. For the last session of Condition 4, Sylvester has no second-half data. This is due to exclusive responding on the right lever during this time. Overall, there were no systematic differences between first- and second-half responding across possums, although the response biases appeared to be greater in the second half of the session during the coconut conditions in a number of cases (for George, Holly and Sylvester in Conditions 4 and 5, and for Arthur in Condition 5 only).

Point estimates of bias were calculated for the first- and second-half response data separately using Equation 3.4 (as previously described). These biases are presented in Table 3.2. It can be seen that during the Cocopops conditions, the overall response biases were greater during the first half of the session for all subjects (i.e., more different from 1.0). During the coconut conditions, the overall response biases were greater during the second half of the

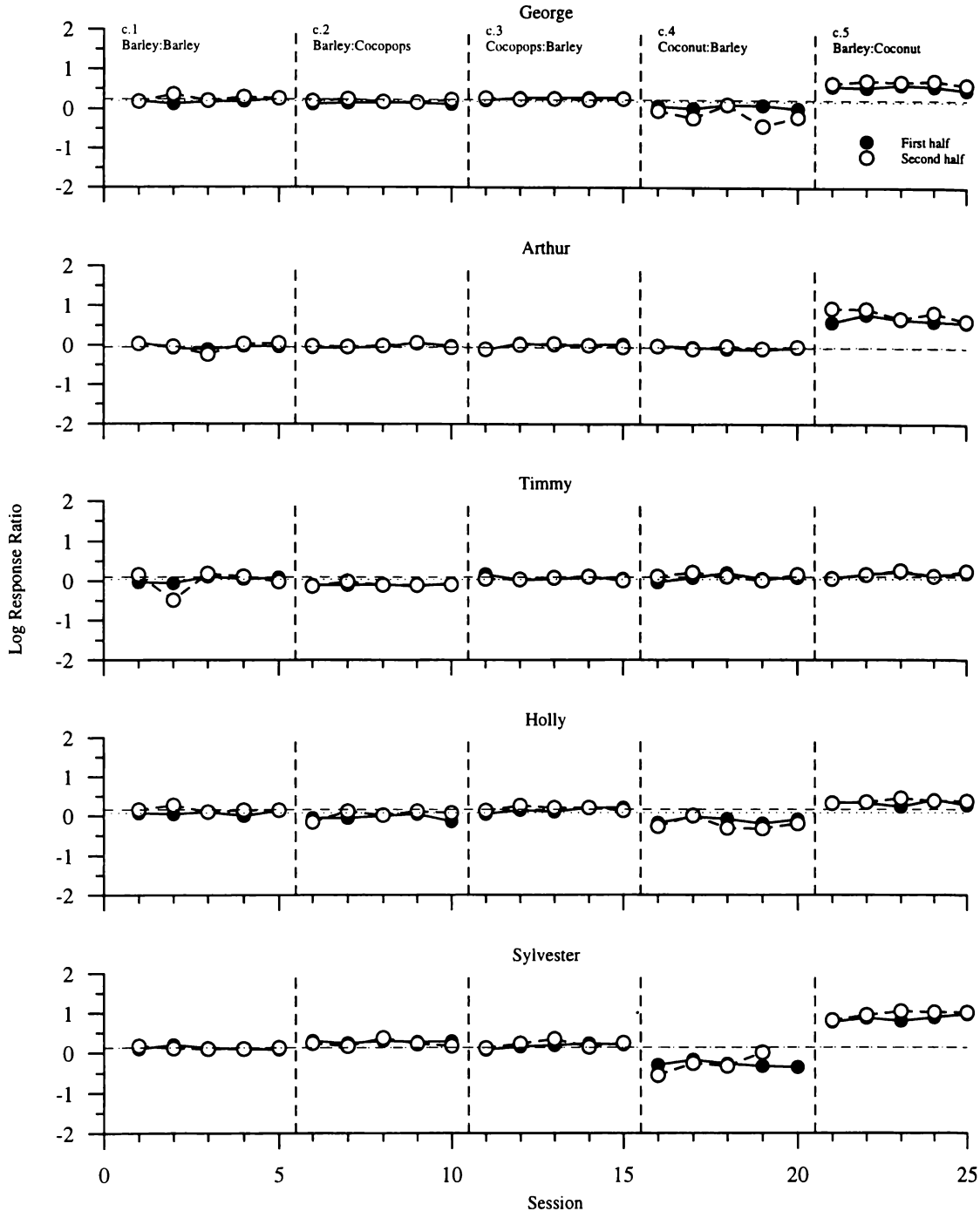


Figure 3.4. The logarithms of the response ratios from each condition plotted for each half of the session.

session for all but 1 subject (the exception being Timmy).

Figure 3.5 shows the logarithms of the time-allocation ratios plotted for the first (filled circles) and second halves (unfilled circles) of the session across the last five sessions of each condition. The inherent biases during both the first and second half of the session (i.e., the average bias measured during Condition 1) are represented on each graph by the dotted (first half) and dashed lines (second half). Again, there is no second-half data point from the last session of Condition 4 for Sylvester, due to this subject not allocating any time to the left lever. There was very little difference between the inherent biases in each half of the session (Condition 1). This was also the case when Cocopops were presented (Conditions 2 and 3). During the first coconut condition (Condition 4), the time biases for 2 subjects (George and Sylvester) were generally larger during the second half of the session, while for 1 subject (Holly) time bias was larger during the first half. The remaining subjects' time biases were not different in the first and second half of the session. For all but 1 subject during the second coconut condition (Condition 5), the time bias was greater during the second half of the session. The bias for the remaining subject (Timmy) was not different across the first and second halves of the session.

Overall time-bias measures were calculated for both the first and second half of the session, as for the overall response-bias measures, and are presented in Table 3.2. Unlike the observed response biases, there were no consistent differences between the first- and second-half overall time biases when either Cocopops or coconut were presented, although the inherent biases was generally slightly greater during the first half of the session.

Figure 3.6 shows the logarithms of the ratios of post-reinforcement pause times (filled circles) and the logarithms of net-times (total time minus post-reinforcement-pause time) allocated to each lever (unfilled circles), plotted for each of the last five sessions from each condition. The dotted lines represent the PRP- time inherent biases (i.e., the average PRP-time biases from Condition 1), while the dashed lines represent the net-time inherent bias. The inherent PRP-time biases (from Condition 1) were towards the left lever for all but 1 subject

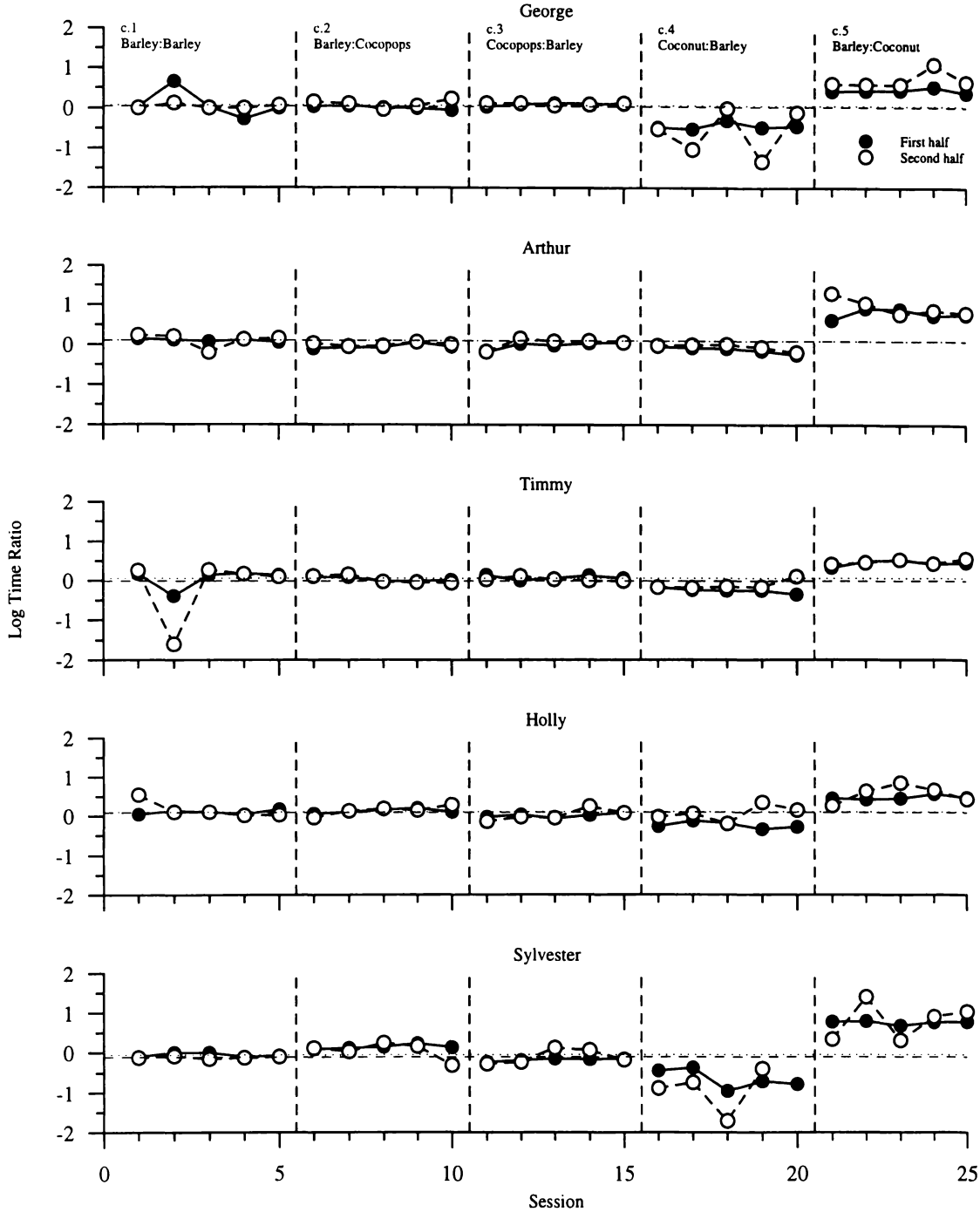


Figure 3.5. The logarithms of the time-allocation ratios from each condition plotted for each half of the session.

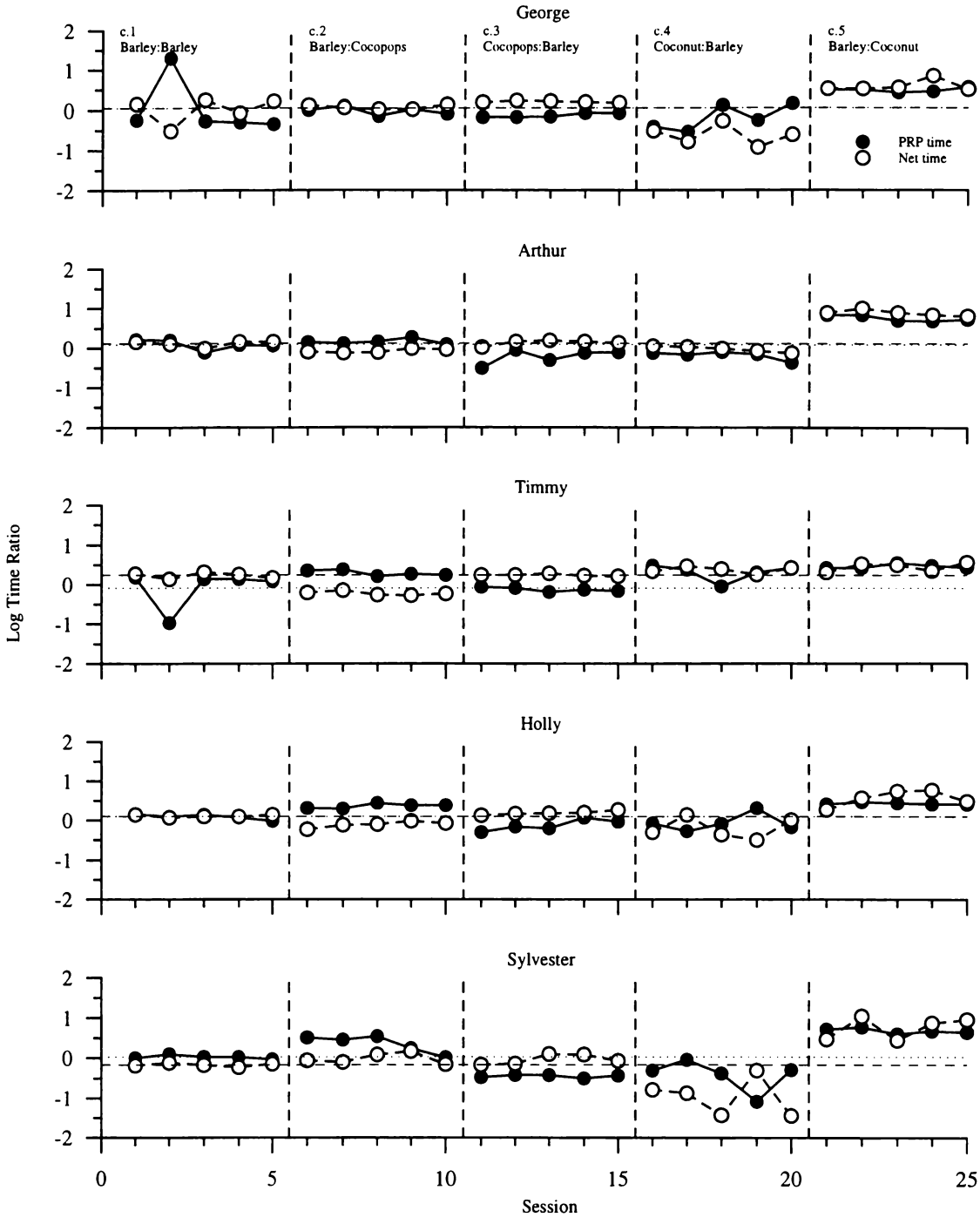


Figure 3.6. The logarithms of the post-reinforcement pause time ratios and the logarithms of the net-time-allocation ratios plotted for each of the last five sessions from each condition.

(Timmy). These biases were in the opposite direction to those obtained during Experiment 1 for all but 1 subject (Holly). The inherent net-time-allocation biases were towards the left for all subjects but Sylvester. For 3 subjects, the net-time-allocation biases obtained during Condition 1 were in the same direction as those from Experiment 1 (the exceptions being Timmy and Holly). During the Cocopops conditions, the PRP-time and net-time biases were in the opposite direction (except during Condition 2 for Sylvester). The PRP-time and net-time-allocation biases were always in the same direction during the coconut conditions (Conditions 4 and 5), however the net-time-allocation biases were generally larger (except during Condition 4 for Arthur, and Condition 5 for Timmy).

Overall biases were also calculated from these data and are presented in Table 3.2. The overall PRP-time biases for all subjects were towards barley in both the Cocopops and coconut conditions. There appear to be no systematic differences between overall PRP-time-allocation biases and overall total-time-allocation biases. The overall net-time-allocation biases obtained in the Cocopops conditions tended more towards Cocopops than did overall total time-allocation biases for all subjects, and the biases were in opposite directions for 1 subject (Holly). In the coconut conditions, 3 subjects' overall biases were larger for the net-time-allocation data than for total time-allocation data, while the remaining 2 subjects' biases were smaller. However, overall bias was still towards barley for all subjects. The overall response and net-time-allocation biases were in the same direction for all subjects in both the Cocopops and coconut conditions.

Changeover Rates

The rates of changeover (averaged over the last five sessions from each condition) are plotted in Figure 3.7 as functions of the logarithms of the time-allocation ratios (left panel) and the logarithms of the ratio of responses (right panel). It can be seen from this figure that the greatest rate of changing over occurred when the time-allocation ratio was approximately zero (i.e., no time bias was present) for all subjects. However, an approximate inverted U-shaped

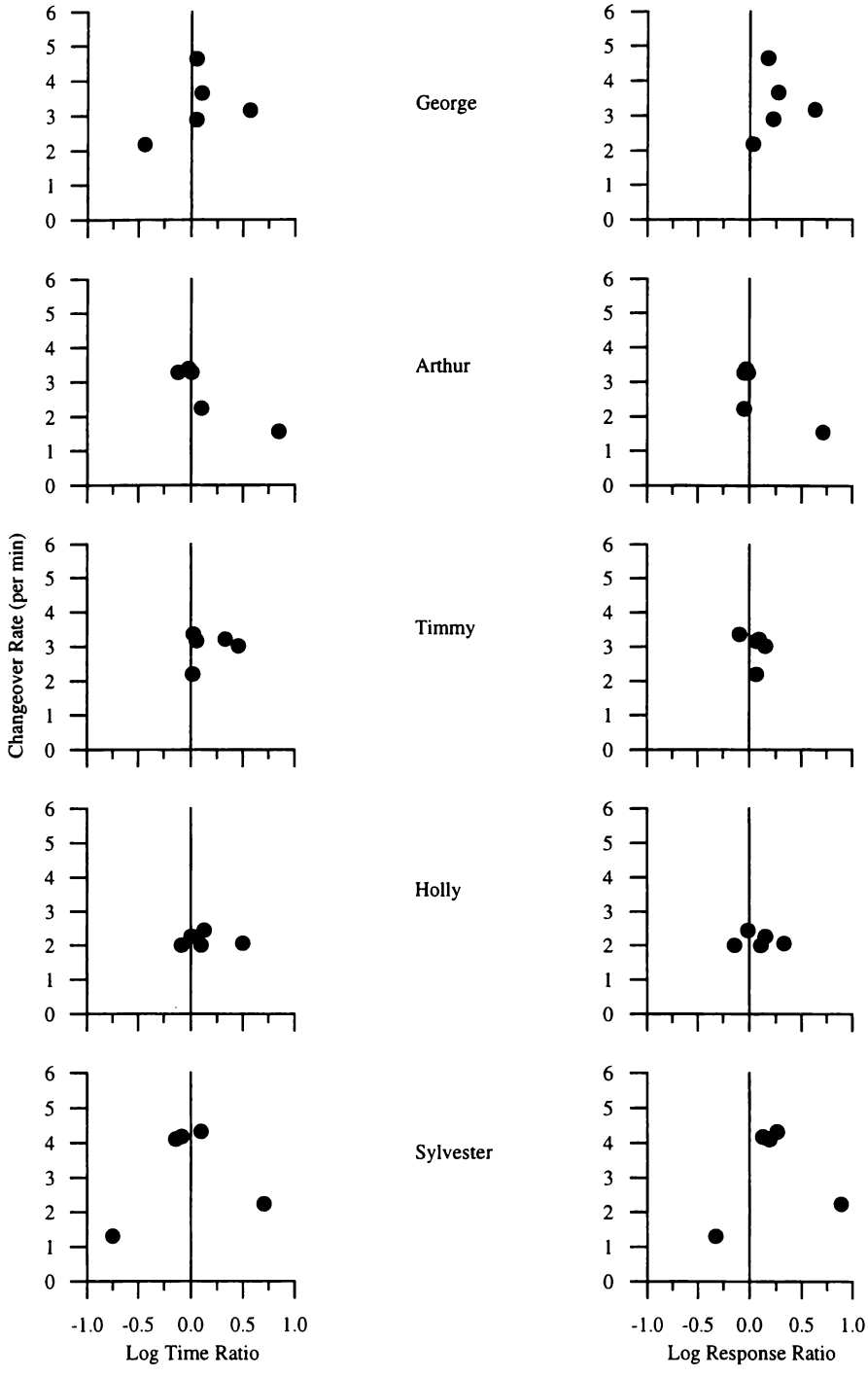


Figure 3.7. The number of changeovers made per minute during each condition plotted as a function of the logarithms of the time-allocation ratios (left panel) and the logarithms of the ratio of responses (right panel).

function was present for only 2 subjects (i.e., for Arthur and Sylvester, the rate of CO generally decreased as distance from the maximum rate increased). When the rates of CO were plotted against response allocation, only 3 subjects (Arthur, Timmy and Holly) showed maximum rates of CO when the logarithms of the response ratios were approximately zero. An approximate inverted U-shaped function was present for only 2 subjects (Holly and Sylvester) when rate of CO was plotted against the logarithms of the response ratios.

Response Rates

The absolute response rates (number of responses made on each lever divided by total session time) for each subject are plotted for each condition in Figure 3.8. The data from the left and right levers are shown separately (left and right panels respectively). The first-half (filled circles) and second-half (unfilled circles) data are also plotted separately on each graph. For all subjects, the absolute rates of responding were generally lower in the second half of the session on both levers, irrespective of the associated food. However, this effect was small for all subjects except Sylvester.

The left panel of Figure 3.9 shows the absolute response rates (per minute) for the whole session, averaged over the last five sessions of each condition. Responses made on the left (filled circles) and right manipulanda (unfilled circles) are plotted separately. The results from the two Cocopops Conditions (Conditions 2 and 3) show that, for 2 subjects (Timmy and Holly), responding was faster on each lever when it was associated with Cocopops (i.e., responding on the right lever was faster during Condition 2 than Condition 3, while responding on the left lever was faster during Condition 3 than Condition 2). For Sylvester, during the Cocopops Conditions, responding was faster on the left lever when it was associated with barley (Condition 2) than when it was associated with Cocopops (Condition 3), while the rates of responding on the right lever were approximately equal during the two Cocopops Conditions. The absolute response rates for the other subjects (George and Arthur) decreased on both levers from Condition 2 to Condition 3. During the Coconut Conditions

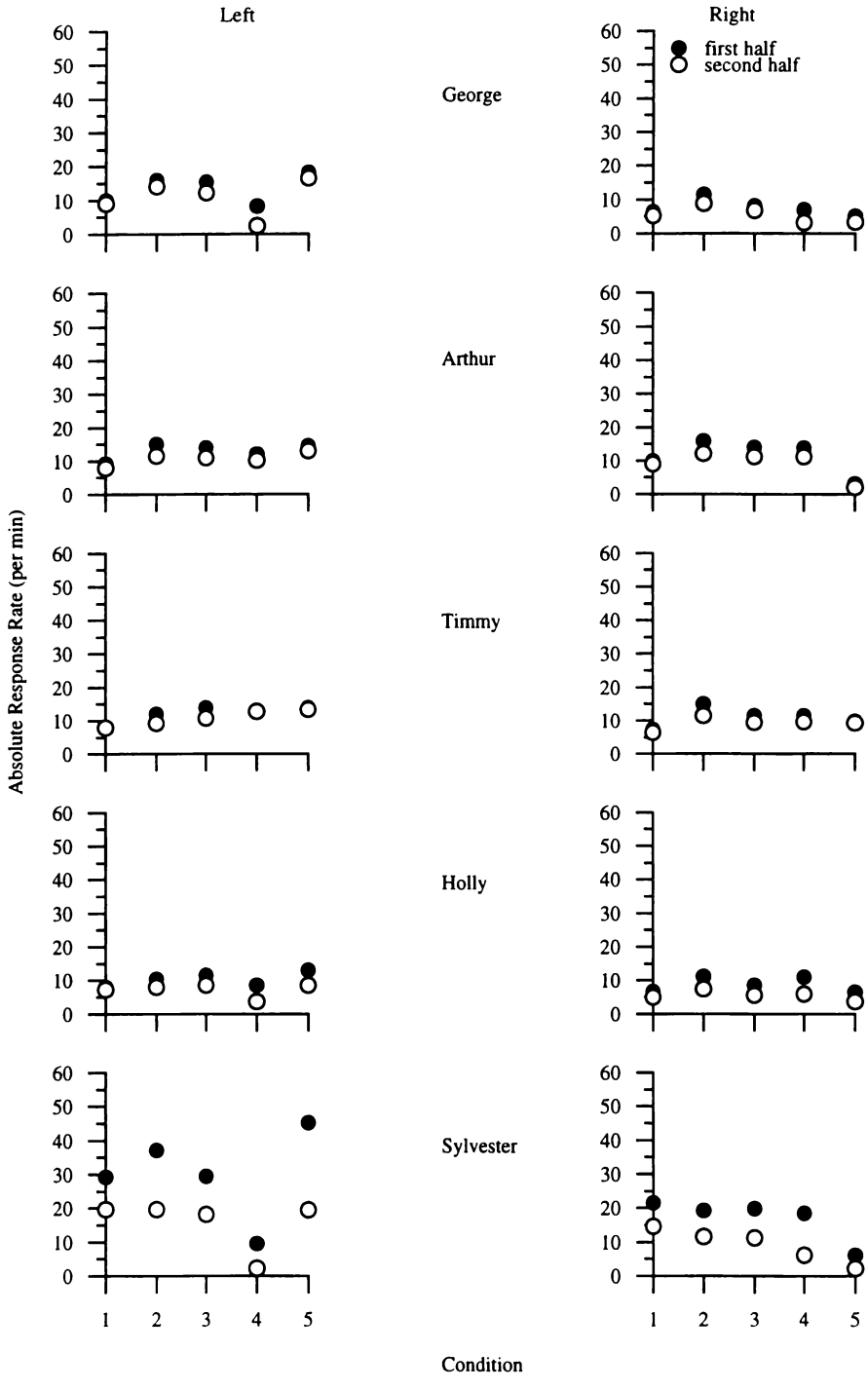


Figure 3.8. The absolute response rates on the left and right manipulanda plotted for each condition for the first and second halves of the sessions.

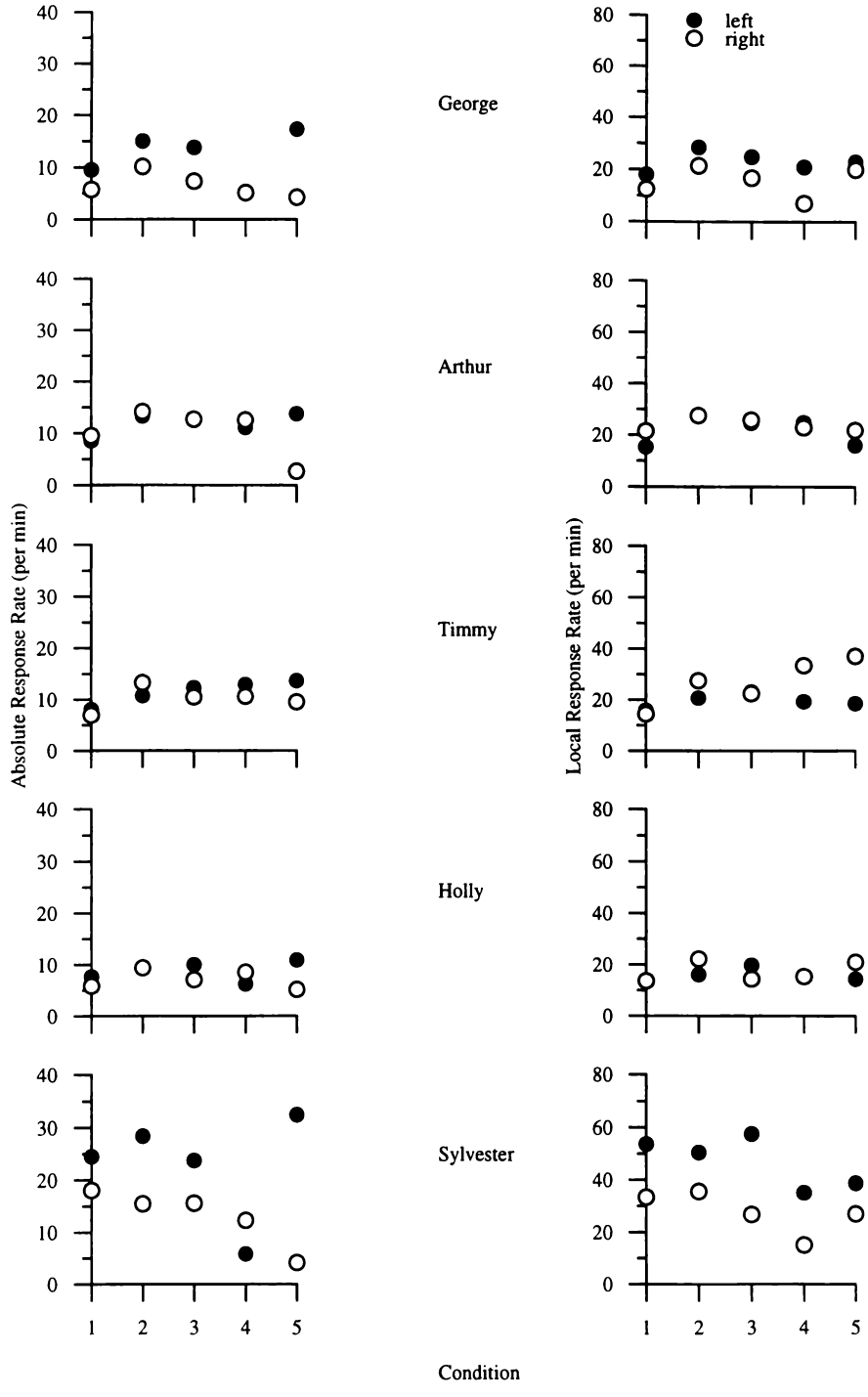


Figure 3.9. The absolute response rates (left panel) and local response rates (right panel) on the left and right manipulandum plotted for each condition.

(Conditions 4 and 5), the absolute response rates for all subjects were faster on the lever associated with barley than that associated with coconut (i.e., for all subjects, responding on the right lever was faster during Condition 4 than Condition 5, while responding on the left lever was faster during Condition 5 than Condition 4).

The local response rates (number of responses made on each lever divided by the time (minutes) spent responding on that lever) are plotted for each session in Figure 3.10. Again, the data are plotted separately for responding on the left lever (left panel) and the right lever (right panel), and the data from the first half (filled circles) and the second half (unfilled circles) of the sessions have been separated. In general, the local rates of responding tended to be lower for the second half of the session, as was the case with absolute rates of responding. The only exceptions occurred on the right lever in Condition 5, where the local response rates were equal in the first and second halves for both George and Timmy. Again, the differences between the rates of responding in the first and second halves of the session were greater for Sylvester.

The right panel of Figure 3.9 shows the local response rates (per min) for the whole session, averaged over the last five sessions of each condition. Responses made on the left (filled circles) and right manipulanda (unfilled circles) are plotted separately. When Cocopops were presented (Conditions 2 and 3), 3 subjects responded faster on each lever when it was associated with Cocopops than when it was associated with barley. However, for George and Arthur, the local rate of responding on both levers decreased from Condition 2 to Condition 3. When coconut was presented (Conditions 4 and 5), Timmy and Holly had faster local response rates on the right lever regardless of whether is was associated with coconut or barley. George and Sylvester's response rates increased from Condition 4 to Condition 5 on both levers, while Arthur's response rates decreased from Condition 4 to Condition 5. Unlike the absolute response rates, there appears to be no relation between the local response rates and bias.

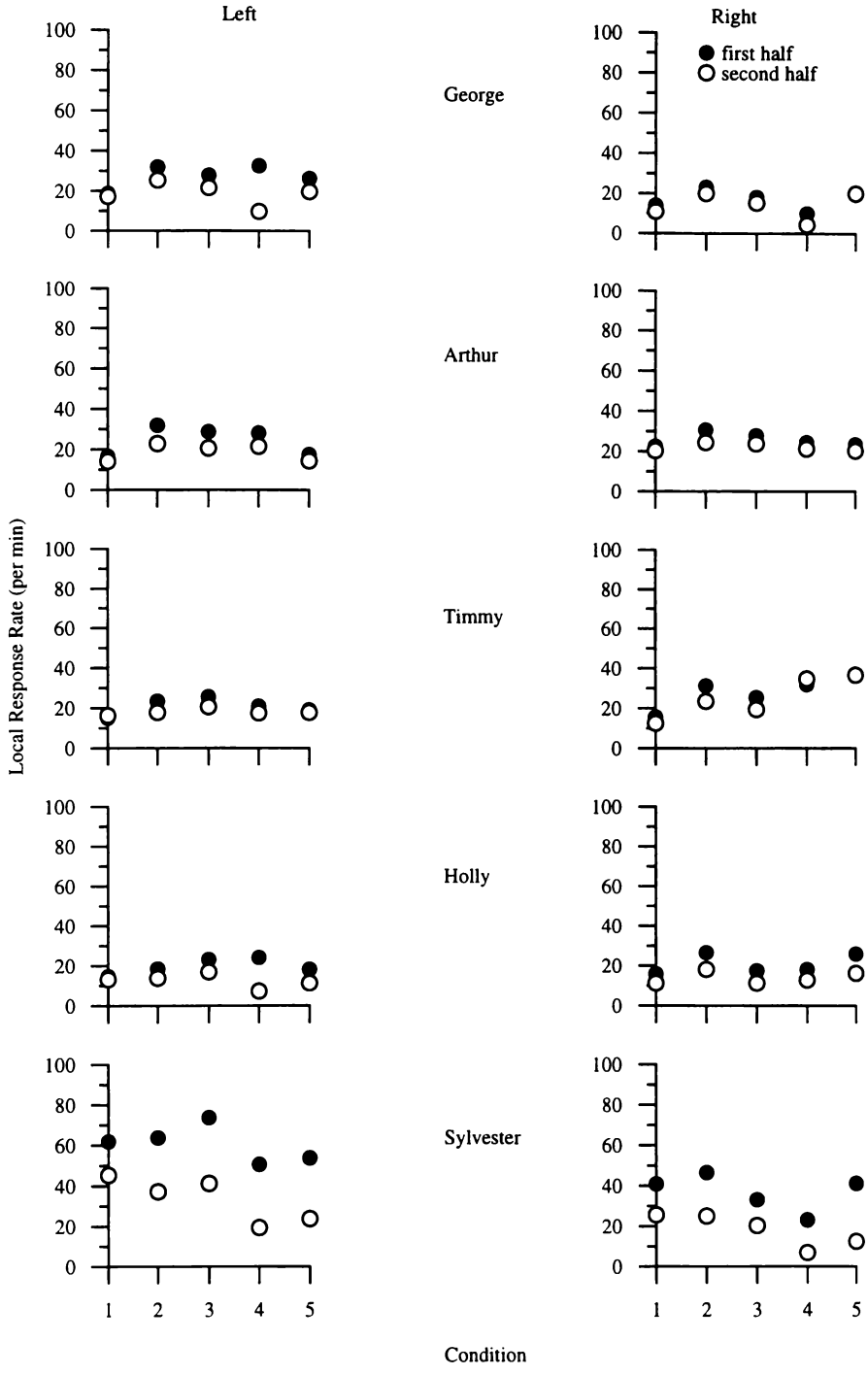


Figure 3.10. The local response rates on the left and right manipulanda plotted for each condition for the first and second halves of the sessions.

# Discussion

## Bias Estimates

The results of the present experiment indicate that when possums respond on equal concurrent VI VI schedules of reinforcement, their response and time measures do exhibit bias when presented with qualitatively different reinforcers. The similarity of the biases from Condition 1 (with barley in both magazines) to those of Experiment 1 (single magazine containing barley) suggests that the change from one magazine to two magazines did not result in a change in the possums' behaviour. The amounts and directions of the biases observed for the different foods varied across subjects. For example, when Cocopops were paired with barley, the most extreme response bias measure (obtained by both Timmy and Holly) was 0.83 (i.e., a preference for Cocopops), while 1 subject showed a response bias towards barley (Sylvester: 1.09). However, the average bias across all subjects was towards Cocopops (0.92). While all subjects preferred barley to coconut in terms of overall response measures, with a mean bias of 2.25, there was again a large range of response biases observed (1.08 - 4.04). The time biases in the present experiment ranged from 0.95 to 1.31 in the Cocopops conditions, with an average overall bias towards barley (1.07). The time biases measured during the coconut conditions were consistently towards barley (ranging from 1.16 - 5.38), with a mean bias of 2.93.

When the overall time- and response-bias measures are compared, it can be seen that, in all but one instance (Arthur – Cocopops vs. barley), the time-bias measures were greater than the response-bias measures (Table 3.2). In other words, the time biases tended to be more in the direction of barley than the response biases, regardless of magnitude.

The magnitudes of the biases reported in previous studies of food preferences using concurrent schedules of reinforcement (e.g., Matthews & Temple, 1979; Miller, 1976) have been similar to those obtained in the present experiment. The biases obtained by Matthews and Temple (1979) ranged from 0.74 to 1.07 (response measures) and 0.74 to 1.32 (time measures), while those

obtained by Miller (1976) ranged from 0.46 to 1.5 (response measures) and 0.63 to 1.6 (time measures). In these experiments, bias was always measured towards the same alternative, therefore biases of less than 1.0 indicate a bias away from that alternative. The ranges of biases from both of these experiments are very similar to those obtained with Cocopops vs. barley in the present experiment. Both Matthews and Temple's (1979) and Miller's (1976) results included instances where an individual subject's time and response measures of bias were in opposite directions. Therefore, it appears that this finding in the present experiment is not unusual.

In the present experiment, the response biases from the first and second halves of the session consistently differed. During the Cocopops Conditions, the response biases were larger in the first half of the session, while during the Coconut Conditions, the response biases were larger in the second half of the session. Overall, the possums' biases were towards the Cocopops, therefore, smaller biases indicate that preference was shifting away from the Cocopops during the second half of the session. On the other hand, the possums' biases were away from the Coconut, with larger biases again indicating that preference was shifting away from this food. This change in bias may be due to differential satiation, with possums satiating to Cocopops and coconut more quickly than to barley. However, McSweeney, Hinson and Cannon (1996) and McSweeney, Weatherly and Swindell (1996) suggested that sensitisation or habituation to the experimental conditions were more likely to be responsible for within-session changes in responding than satiation. The basis for this argument included a study in which the caloric density of the reinforcer (using different foods), the size of the reinforcer, and the deprivation of the subject were varied (Roll, McSweeney, Johnson & Weatherly, 1995). Varying these factors did not result in differences in within-session changes in responding. However, in that experiment, only one food was available within a session. The change in bias from the first to the second half of the session in the present experiment, suggests that the different foods may be responsible for the present result. If differential satiation were not occurring here, it should be expected that the change in responding during the

session would be the same on both of the schedules (since the only difference between the two alternatives is the reinforcer), and therefore, bias would not change. Had only one of these foods been presented within a session, it is likely, based on the results of Roll et al.'s (1995) study, that within-session changes would have been similar for the two foods. However, by presenting the two foods concurrently, the subject is given the opportunity to choose between them, and therefore, to eat more of one food than the other, as opposed to being in a situation where the only choice is to eat or not eat. Therefore, it is possible that the possums satiated to the Cocopops and coconut, and this is reflected in the shift in bias away from these alternatives from the first half to the second half of the session.

While a change in bias from the first to the second half of the session was also observed when the barley/carob mixture was presented in both magazines in this experiment, a similar change was not consistently observed with the same subjects during Experiment 1 (with only one magazine). It is possible, however, that each pair of magazines were not exactly identical, and it may have been that a possum could more easily obtain ford from one or other magazine. It was likely, therefore, that the amount of food able to be obtained by the possums during a reinforcer differed across magazines. This would result in a difference in the magnitudes of the reinforcers available from each magazine, with subjects behaviour being biased towards the larger reinforcer. The change in bias in this case could also be due to these differences in that, as the rate of responding for the reinforcer decreased over the session, the subjects may have worked consistently harder to obtain access to the more generous of the two magazines during the second half of the session. This suggestion was not tested in this research and it remains to be seen whether switching the magazines would change the direction of the bias changes.

In both the Matthews and Temple (1979) and Miller (1976) experiments, the degree of bias observed with response measures was greater than that observed with time measures. This result was also found in Hollard and Davison's (1971) study of preference between food and brain stimulation in the pigeon, and Sumpter et al.'s (1995) study of response type and number preferences in hens. The opposite result was recorded in 7 of the 10 cases in the present experiment (with mean time biases being larger than mean response biases with both Cocopops and coconut). In Experiment 1, it was found that possums' lever pressing was less sensitive to the reinforcement contingencies than was time-allocation (much more so than is normally found with other species). In that experiment it was suggested that time spent pausing after a reinforcer was obtained may have contributed to the greater sensitivity to changes in the reinforcer rate observed with time-allocation. When this pause-time was removed, the remaining net-time sensitivity was more similar to response sensitivity. However, net-time bias was generally larger than total-time bias. When PRP-time was removed before the bias calculations in the present experiment, larger net-time biases were again found. This resulted in a larger difference between response and net-time bias measures than was observed between response and total-time bias measures in most cases.

Responding within the changeover delay in the present experiment showed only a very small amount of bias in all conditions. As a result, the post-COD biases were larger than the total-response bias measures. No other studies have reported behaviour within the COD when studying food preferences, however McAdie et al. (1996) studied hens' behaviour during the COD with a noise biaser present. In that experiment, a noise was constantly present while the hen was responding on the associated key (i.e., from the first peck on that key until the first peck on the alternate key). The results of McAdie et al.'s experiment showed that the amount of bias due to the noise was much smaller during the COD than after it. They suggested that this finding could be explained by Herrnstein's (1961) suggestion that the COD separates the schedules in such a way that responses during the COD do not come under the control of either

schedule. Because of this, they also suggested that post-COD data provide the "better" estimate of bias. This result is consistent with that found in the present experiment. In addition, the present experiment found that the within-COD bias was relatively stable across conditions (i.e., there was very little deviation from the inherent bias measured during Condition 1). This suggests that the behaviour which occurred within the COD was not affected by the different foods presented. Therefore, as with noise biasers in McAdie et al.'s study, it appears that post-COD bias estimates are "better" than estimates which use total-response data. This provides further support for Baum's (1982) and Temple et al.'s (1995) suggestion that behaviour during the COD should not be included in the analysis of behaviour under concurrent schedules of reinforcement.

A constant bias towards barley was observed in the post-reinforcement-pause-time data in all conditions. However, the size of this bias was not consistent across the Cocopops and Coconut Conditions. A possible reason for this bias is that barley may simply take longer for the possums to eat, as it is noticeably harder to chew. When PRP-time was removed from total time, the remaining bias (net-time bias), in general, was more similar to the response bias both in direction and in magnitude than was total-time bias. Since it appears that post-reinforcement-pause time may have been affected by the different reinforcers, apparently independently of either preference or the schedules of reinforcement, it may be appropriate to remove the post-reinforcement-pause-time data prior to analysis. This possibility will be explored later.

Changeover Rates

The changeover rates in the present experiment varied systematically with the logarithms of the time-allocation ratios. The rates of changeover were greater when approximately equal amounts of time were spent on each lever (i.e., the subject's behaviour was not showing bias), while, when the time-allocation ratios tended towards the extremes (i.e., subject's behaviour was showing bias), the amount of changing over decreased. This was not the case when rates of changing over were plotted against the logarithms of the response ratios. In

Experiment 1, the changeover rates were plotted against the obtained reinforcement rates. Since this rate was held constant in the present experiment, the logarithms of the time- and response-allocation ratios were used instead. The relation between changeover rates and the log time ratios was similar to that normally found when the log reinforcement rates are used (Baum, 1974; Catania, 1963; Herrnstein, 1961; Sumpter et al., 1995). Previous experiments have also plotted CO rate as a function of log time and response ratios (Baum, 1976; Miller, 1976), and have found an approximate inverted U-shaped function, similar to that expected when plotting CO rate against the log reinforcer ratio. However, Baum (1976) found that the log reinforcer ratio provided a slightly closer approximation to the expected function.

Because plotting the changeover rates against the logarithms of the time-allocation ratios in the present experiment gave a similar result to plotting the CO rates against the logarithms of the reinforcer ratio in previous experiments, the CO rates from Experiment 1 were re-analysed here. Figure 3.11 shows the changeover rates from Experiment 1 plotted against the logarithms of the time ratios (left panel) and the logarithms of the response ratios (centre panel). The CO rates are also presented again as functions of the log programmed reinforcer ratios for comparison. In general, a closer approximation to an inverted U-shaped function was observed when the log time ratios were used. This is particularly noticeable for Holly and Sylvester's data. The difference in the log time ratios appears to account for the difference in CO rates from the two equal-schedule conditions. Again, when the CO rates were plotted against the log response ratios an inverted U-shaped function was generally not observed. The logarithms of the reinforcer ratios may not have corresponded as well to rates of changeover in this experiment due to the use of dependent schedules. Baum's (1976) experiment, in which the log reinforcer ratios provided the better fit, used independent schedules of reinforcement. The log time ratios were also found to provide a better fit for CO rates with hens by Sumpter et al. (1998). In this experiment, when the CO rates were plotted against the log reinforcer ratios, the maximum rates of changing over did not occur at log ratios of zero as was expected. However, this was the

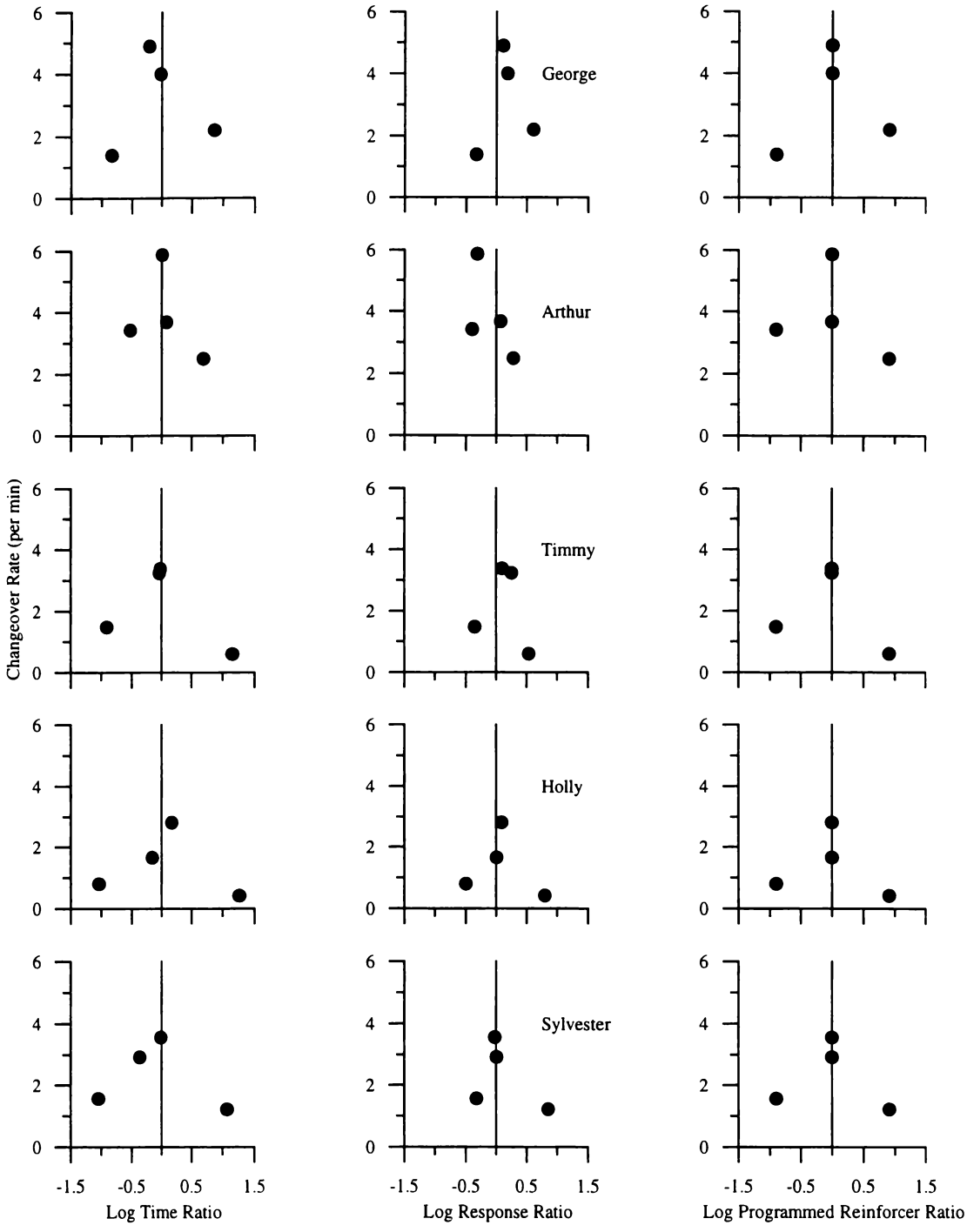


Figure 3.11. The rates of changing over during Experiment 1 plotted against the logarithms of the time-allocation ratios, the response-allocation ratios, and the reinforcer-rate ratios for each possum.

case when the CO rates were plotted against the log time ratios. Since CO rate is related to preference (i.e., when preference is greatest, subjects make the least number of changeovers: Baum, 1976), and rate of changing over only varies systematically with time-based estimates of preference, this suggests that, for possums, time measures of bias may be more appropriate than response measures.

Response Rates

The absolute rates of responding observed in the present experiment appear to be related to the possums' preference. For all subjects (except George and Arthur on Cocopops trials), responding on the alternative associated with the preferred food was faster. On the other hand, the local rates of responding did not appear to be related to bias. The finding that absolute response rate is related to preference is logical, in that the absolute rate of responding is determined by the number of responses made on a particular alternative. If a subject's behaviour is biased towards an alternative (on equal schedules), the total number of responses will be higher and, since the session length is constant for both alternatives, the absolute response rate will be higher.

Both the absolute and local response rates were generally lower in the second half of the session. This was only the case for 2 subjects in Experiment 1, where only one food was available, suggesting that the different foods available in the present experiment may have contributed to this result. This drop in response rates suggests that Cocopops and coconut are not successful in maintaining behaviour for the entire length of the session. This is supported by the fact that, for 1 subject, during one of the Coconut Conditions, no responses were made on the lever associated with the coconut during the second half of the session. Therefore, it may be necessary to identify foods which will maintain responding for longer periods before studying food preferences further.

The results obtained in this experiment suggest that concurrent schedules of reinforcement are an appropriate means for determining the degree of food preferences of possums. Possums' responding for qualitatively different reinforcers in the present experiment was similar to that observed with other

species. When Cocopops was presented versus barley, the biases were very small. This suggests that the possums did not have a strong preference for one food over the other. When coconut was presented versus barley, however, all possums showed large biases towards barley. It remains to be seen how bias due to qualitatively different reinforcers changes with changes in the reinforcer-rate ratio, and how well the GML and the C-D model describe such data. However, since the biases observed with Cocopops were small, and behaviour was not well maintained with coconut, an alternative food is required. Since barley has already been shown to maintain possums' behaviour, in the next experiment barley was associated with responses made to both alternatives, however, the quality of the barley associated with one of the alternatives was manipulated by adding different concentrations of salt.

# EXPERIMENT 4

In Experiment 1, concurrent schedules of reinforcement were found to be an effective means of studying the choice behaviour of possums. Experiment 3 examined whether concurrent schedules could be used to study the effects of biasers on the possums' behaviour, using different food alternatives. Providing different reinforcers for responses on each of the two alternatives did produce changes in the possums' response- and time-allocation measures. The magnitudes of the biases found with Cocopops versus barley were small and similar to those previously observed with different foods in other species (e.g., Matthews & Temple, 1979; Miller, 1976), however, much larger biases were observed in the coconut versus barley conditions.

While different biases were obtained when Cocopops and coconut were paired with barley, it remains to be seen whether graded measures of bias can be obtained under concurrent schedules of reinforcement, and whether these biases remain constant over a range of reinforcer-rate ratios. Discussions with a scientist working with possums have suggested that adding a low salt concentration to a particular food may result in possums showing an increased preference towards that food, with higher salt concentrations being less preferred (Fisher, personal communication). For this reason, the present experiment examined whether the use of several different concentrations of salt added to barley (as opposed to different magnitudes of barley) has a graded biasing effect on the concurrent-schedule behaviour of the possums. A further aim of this experiment was to examine how the C-D model copes with experimentally introduced biasers. If different biases are obtained with the different foods, it might be expected that the value of $d_r$ in the C-D model will also change when different foods are presented in each magazine. According to Davison and Jenkins (1985), the parameter $d_r$ measures how well the subject can discriminate the response-reinforcer contingencies. Therefore, following on from Davison and Jenkins' definition of $d_r$, if the reinforcers given for responses on each alternative (or for each response) are different, it should be easier for the subject to determine which response

produced the reinforcer, and this should result in an increase in discriminability.

## Method

### Subjects

The subjects were the same as those used in Experiments 1 and 3. At the end of Condition 13, however, Arthur died, and was replaced by Maggie. Maggie was an experimentally naïve subject. Lever presses were trained using the method of successive approximations. Once responding on both levers occurred reliably, concurrent VI 7.5-s VI 7.5-s schedules of reinforcement were introduced with no COD. The schedules were gradually increased to concurrent VI 40 s VI 40 s over 32 sessions, after which the COD was increased from 0 s to 4 s (being the first experimental condition) over a further 10 sessions.

### Apparatus

The experimental equipment was identical to that used in Experiment 3.

### Procedure

In all conditions, either the left or right magazine (depending on the condition) contained a mixture of steam-flaked barley and carob chips in a ratio of 15:1 (hereafter referred to simply as barley). The other magazine contained barley and carob with varying concentrations of salt, ranging from 0% to 6% (hereafter referred to by the percentage of salt added). The salt concentration was calculated based on the weight of the barley. For example, when 6% salt was required, if 1000 g of barley was used, 60 g of salt would be added. In order to add salt to the barley, and to ensure an even distribution throughout, the salt was first dissolved in water. The barley and salted water were then mixed and dried in an oven designed for the drying of plant material, at 80° C for approximately 24 hours (or until completely dry). The barley for the 0% salt conditions was simply wet and then dried to serve as a baseline for comparison with subsequent concentrations. This was necessary because after the barley had been dried, it was noticeably

harder to chew. The carob was added after the barley had been dried, and allowed to cool.

The order of conditions, and the number of sessions per condition are presented in Table 4.1. During Conditions 1 to 10, reinforcement was available on a dependent concurrent VI 40-s VI 40-s schedule of reinforcement during all conditions (arranged as in Experiment 1), and the lever associated with the salt, as well as the concentration of salt, was changed across conditions. For Conditions 11 to 15, the lever associated with the salt, and the salt concentration were kept constant (6% salt, associated with the left lever), while the schedules of reinforcement associated with each lever were changed across conditions. During Conditions 16 to 20, 6% salt was replaced with 4% salt. In all other respects, these conditions were identical to Conditions 11 to 20. The final condition (Condition 21) was a replication of Condition 8. Each condition was changed as soon as the behaviour of all subjects had reached graphical stability as judged by at least two lab members (i.e., when the proportion of left responses over the last five sessions was not trending).

Condition 3 (barley vs. barley) was included, as a break between conditions, due to a shortage of barley with 0% salt at that time. In this case, 4 of the 5 possums had reached stability, and were put back on the barley vs barley condition until the last possum reached stability. Data from this condition are not presented here. Condition 5 (2% salt (new carob) vs. barley (new carob)) was conducted with 3 possums (who reached stability on Condition 4 before the remaining 2 possums) because it was necessary to change the supplier of the carob chips which were mixed with the barley. Although carob chips were mixed with both the salted and unsalted barley, the new carob was tested for five sessions with these possums to ensure that it did not affect the data obtained. The data obtained during Condition 5 are not presented here as they did not differ noticeably from the data obtained in the previous condition, suggesting that changing the carob did not change the behaviour of the possums. All other aspects of the experiment were the same as for Experiments 1 and 3. All data recorded were the same as for the previous experiments.

Table 4.1
The order of conditions for Experiment 4, and the number of sessions required to reach stability in each condition.

| | Schedules (s) | | Reinforcer | | |
|---|---|---|---|---|---|
| Condition | Left | Right | Left | Right | Sessions |
| 1 | VI 40 | VI 40 | Barley | 0% Salt | 25-39 |
| 2 | VI 40 | VI 40 | 0% Salt | Barley | 19-24 |
| 3 | VI 40 | VI 40 | Barley | Barley | 0-7 |
| 4 | VI 40 | VI 40 | 2% Salt | Barley | 40-45 |
| 5 | VI 40 | VI 40 | 2% Salt* | Barley* | 0-5 |
| 6 | VI 40 | VI 40 | Barley | 2% Salt | 32 |
| 7 | VI 40 | VI 40 | Barley | 4% Salt | 29 |
| 8 | VI 40 | VI 40 | 4% Salt | Barley | 30 |
| 9 | VI 40 | VI 40 | Barley | 6% Salt | 20 |
| 10 | VI 40 | VI 40 | 6% Salt | Barley | 27 |
| 11 | VI 25 | VI 100 | 6% Salt | Barley | 18 |
| 12 | VI 100 | VI 25 | 6% Salt | Barley | 17 |
| 13 | VI 22.5 | VI 180 | 6% Salt | Barley | 33-47 |
| 14 | VI 180 | VI 22.5 | 6% Salt | Barley | 14 |
| 15 | VI 25 | VI 100 | 6% Salt | Barley | 53-57 |
| 16 | VI 25 | VI 100 | 4% Salt | Barley | 23 |
| 17 | VI 100 | VI 25 | 4% Salt | Barley | 20 |
| 18 | VI 22.5 | VI 180 | 4% Salt | Barley | 15-27 |
| 19 | VI 180 | VI 22.5 | 4% Salt | Barley | 45 |
| 20 | VI 25 | VI 100 | 4% Salt | Barley | 36 |
| 21 | VI 40 | VI 40 | 4% Salt | Barley | 41 |

* New carob introduced

## Results

The raw data from the last five sessions of Conditions 1, 2, 4 and 6-21 are presented in Appendix D. All analyses were carried out on the summed data from the last five sessions of each condition. All ratios were taken to the left manipulandum and were logged to the base 10.

### Point Estimates of Bias

The point estimates of bias were calculated using Equation 3.4 as described in the Results section of Experiment 3. A bias value greater than 1.0 (log ratio = 0) indicates a bias towards the barley.

Figure 4.1 shows the logarithms of the point estimates of bias for both response-allocation and time-allocation data plotted against the salt concentration for each possum. The standard deviation of each bias estimate is also presented. The degree of bias is indicated by the distance between the data point and the dotted line (plotted at zero). No consistent changes in the response or time biases were obvious as the concentration of salt was increased from 0% to 6%. The 0% salt condition shows the effect of cooking the barley on the subjects' bias measures. In all but one case (Holly being the exception), the response biases obtained during this condition were towards the uncooked barley alternative. When 2% salt was presented, 3 subjects showed response biases towards the salted alternative, while the remaining 2 subjects' (Arthur and Sylvester) response-allocation measures were biased towards plain barley. When 4% and 6% were presented, the response-allocation measures from all subjects were biased towards the barley.

In terms of time allocation, 3 subjects showed biases towards barley when 0% salt was presented, while 1 subject (Timmy) showed a bias towards 0% salt, and 1 showed no bias (Holly). When 2% salt was presented, 2 subjects (Arthur and Sylvester) showed a time bias towards barley, 2 subjects showed a time bias towards salt, and 1 subject showed no bias (George). When 4% salt was presented, all of the subjects' time-allocation measures were biased towards

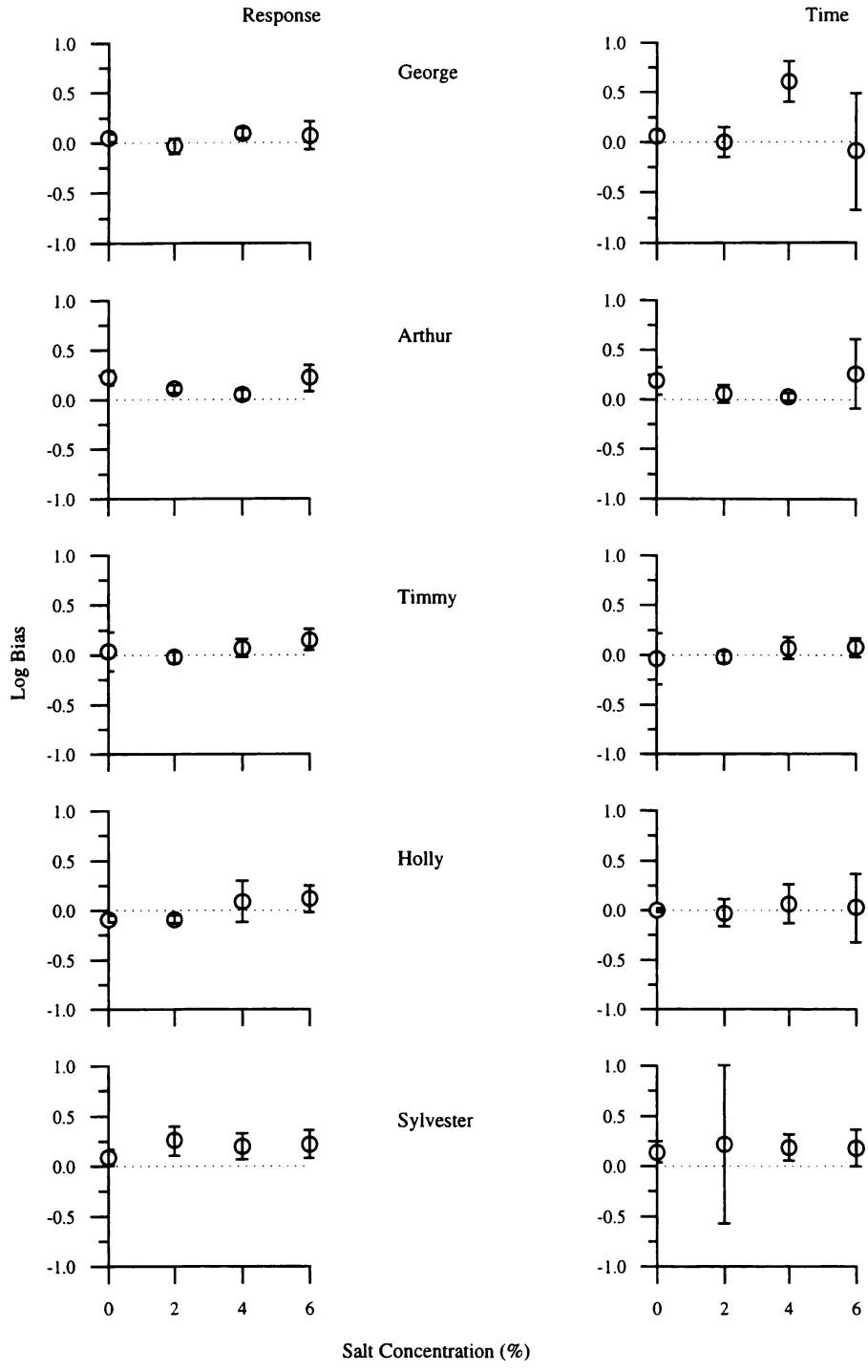


Figure 4.1. The point estimates of bias for each possum based on the response and time data for each of the salt concentrations paired with the crushed barley/carob mixture and equal concurrent VI VI schedules of reinforcement.

Table 4.2
Point estimates of the ratio of bias for each subject when barley/carob mixture was paired with different concentrations of salted barley. Estimates are given for response and time data (both total and first and second half), within and post-COD responses, and PRP and net time data. Bias towards the barley/carob mixture is indicated by a value greater than 1.0.

| Possum | 0% Salt | 2% Salt | 4% Salt | 6% Salt | 0% Salt | 2% Salt | 4% Salt | 6% Salt |
|---|---|---|---|---|---|---|---|---|
| | Responses | | | | Time | | | |
| George | 1.12 | 0.93 | 1.24 | 1.18 | 1.15 | 1.00 | 4.05 | 0.81 |
| Arthur | 1.68 | 1.30 | 1.13 | 1.65 | 1.54 | 1.15 | 1.07 | 1.81 |
| Timmy | 1.09 | 0.95 | 1.18 | 1.42 | 0.91 | 0.95 | 1.17 | 1.19 |
| Holly | 0.82 | 0.81 | 1.23 | 1.31 | 1.00 | 0.94 | 1.15 | 1.06 |
| Sylvester | 1.24 | 1.80 | 1.58 | 1.65 | 1.39 | 1.66 | 1.55 | 1.53 |
| MEAN | 1.19 | 1.16 | 1.27 | 1.44 | 1.20 | 1.14 | 1.80 | 1.28 |
| | Within COD | | | | Post COD | | | |
| George | 1.03 | 0.96 | 1.05 | 0.98 | 1.18 | 0.93 | 1.35 | 1.35 |
| Arthur | 1.16 | 1.05 | 0.97 | 1.09 | 2.03 | 1.41 | 1.23 | 2.10 |
| Timmy | 0.97 | 0.87 | 1.02 | 1.12 | 1.24 | 1.06 | 1.40 | 1.86 |
| Holly | 0.88 | 0.93 | 1.13 | 1.05 | 0.77 | 0.72 | 1.30 | 1.55 |
| Sylvester | 0.97 | 0.99 | 0.93 | 1.07 | 1.53 | 3.17 | 2.75 | 2.57 |
| MEAN | 1.00 | 0.96 | 1.02 | 1.06 | 1.35 | 1.46 | 1.61 | 1.89 |
| | PRP Time | | | | Net Time | | | |
| George | 1.24 | 0.91 | 0.78 | 0.68 | 1.14 | 1.04 | 1.59 | 0.89 |
| Arthur | 1.28 | 1.04 | 0.87 | 0.97 | 1.59 | 1.25 | 1.17 | 2.32 |
| Timmy | 0.71 | 0.84 | 1.02 | 0.99 | 1.28 | 1.13 | 1.44 | 1.61 |
| Holly | 1.01 | 0.99 | 1.14 | 0.96 | 0.97 | 0.85 | 1.17 | 1.44 |
| Sylvester | 0.88 | 0.52 | 1.14 | 1.41 | 1.89 | 3.99 | 1.94 | 1.60 |
| MEAN | 1.02 | 0.86 | 0.99 | 1.00 | 1.37 | 1.65 | 1.46 | 1.57 |
| | First Half Responses | | | | Second Half Responses | | | |
| George | 1.11 | 0.93 | 1.23 | 1.10 | 1.13 | 0.93 | 1.27 | 1.24 |
| Arthur | 1.76 | 1.34 | 1.12 | 1.57 | 1.56 | 1.24 | 1.14 | 1.74 |
| Timmy | 1.06 | 0.98 | 1.14 | 1.46 | 1.09 | 0.93 | 1.21 | 1.38 |
| Holly | 0.84 | 0.80 | 1.13 | 1.19 | 0.79 | 0.80 | 1.38 | 1.52 |
| Sylvester | 1.17 | 1.59 | 1.38 | 1.52 | 1.40 | 3.51 | 1.95 | 1.89 |
| MEAN | 1.19 | 1.13 | 1.20 | 1.37 | 1.19 | 1.48 | 1.39 | 1.55 |
| | First Half Time | | | | Second Half Time | | | |
| George | 1.14 | 1.03 | 1.06 | 0.82 | 1.17 | 0.98 | 1.58 | 0.81 |
| Arthur | 1.64 | 1.15 | 1.03 | 1.45 | 1.45 | 1.15 | 1.11 | 2.28 |
| Timmy | 0.86 | 0.93 | 1.10 | 1.16 | 0.96 | 0.96 | 1.24 | 1.22 |
| Holly | 0.98 | 0.91 | 1.04 | 1.12 | 1.01 | 0.96 | 1.28 | 1.01 |
| Sylvester | 1.21 | 1.36 | 1.39 | 1.48 | 1.64 | 2.06 | 1.72 | 1.57 |
| MEAN | 1.17 | 1.08 | 1.12 | 1.21 | 1.25 | 1.22 | 1.39 | 1.38 |

barley. All but 1 subjects' time allocation was biased towards barley when 6% salt was presented (the exception being George). In general, the time bias estimates were more variable than the response bias estimates. This is illustrated by the standard error bars, which are generally larger for the time estimates than for the response estimates.

Table 4.2 gives the bias measures calculated as described for Experiment 3. The mean data show that the degree of the overall response bias towards barley decreased from the 0% to the 2% salt conditions, and increased as the salt concentration increased beyond 2%. However, the response biases of only 2 subjects (Timmy and Holly) systematically increased with subsequent increases in salt concentration. The overall time biases showed no systematic changes with increases in salt concentration. The mean time data showed that 4% salt was the least preferred of the salt concentrations, while 2% salt was the most preferred salt concentration.

The logarithms of the point estimates of the response-allocation biases obtained during the first (left panel) and second half (right panel) of the session are plotted for each salt concentration in Figure 4.2. For 3 subjects (George, Arthur and Timmy), there were no consistent differences between the first- and second-half response biases across conditions, while 1 subject (Sylvester) showed larger biases in the second half of the session in most conditions. This was also true for Holly during the 4% and 6% salt conditions. For 2 subjects (Holly and Sylvester), the response bias estimates obtained from the second half of the session were generally more variable (i.e., the standard deviations were larger) than those obtained from the first half. For the remaining 3 subjects, there were no consistent differences.

The overall response bias measures calculated separately for the data from the first and second half of the session (as in Experiment 3) are also presented in Table 4.2. In most cases (15 out of 20), the response biases from the second half of the session were greater than those from the first half of the session (indicated by a ratio more different from 1.0), particularly at higher salt concentrations.

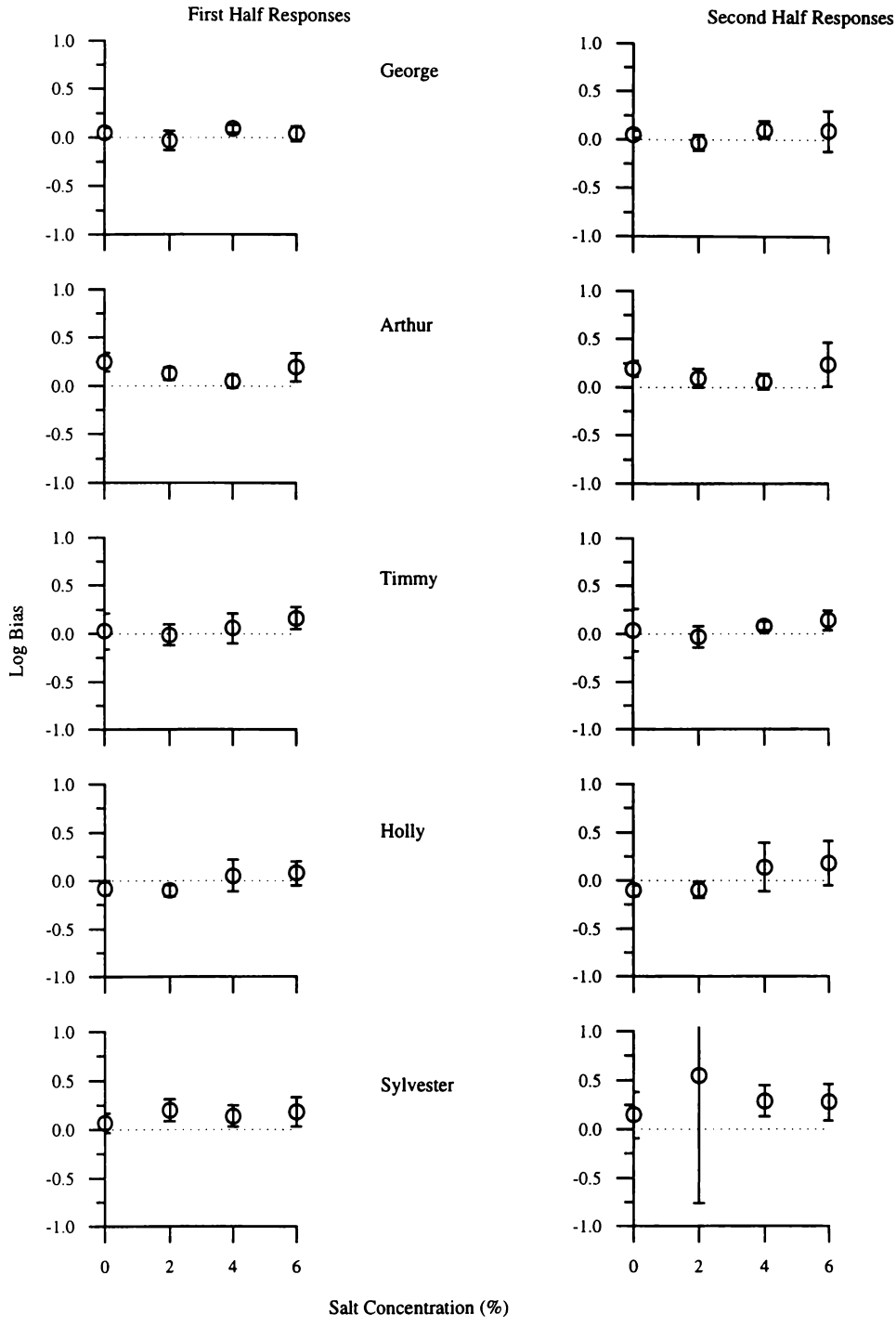


Figure 4.2. The point estimates of bias for each possum based on the first and second half response data for each of the salt concentrations paired with the crushed barley/carob mixture and equal concurrent VI VI schedules of reinforcement.

Figure 4.3 shows the logarithms of the point estimates of the time-allocation biases from the first (left panel) and second half (right panel) of the session, plotted for each possum at each salt concentration. For 4 of the 5 subjects, there were no consistent differences between the first- and second-half time allocation biases across conditions. The exception (Sylvester) tended to show larger time biases during the second half of the session. For 3 subjects (George, Holly and Sylvester), the time bias estimates obtained from the second half of the session were generally more variable than those obtained from the first half. There were no consistent differences in the variability of these measures for the remaining subjects.

Table 4.2 shows the overall time-allocation biases from the first and second half of the session. When 0% and 2% salt were presented, the time-allocation biases tended to be greater during the first half of the session (indicated by a ratio further away from 1.0). When 4% and 6% salt were presented, most subjects' time-allocation biases were greater during the second half of the session.

The logarithms of the point estimates of the response-allocation biases from within (left panel) and after (right panel) the COD are plotted against the salt concentration for each subject in Figure 4.4. Generally, the within-COD biases were small (close to zero), showing no consistent changes in bias with changes in salt concentration. In most cases (17 of 20), the post-COD biases were clearly larger than the within-COD biases (i.e., further away from zero), while the within- and post-COD biases were in the same direction in only 10 of 20 cases. The post-COD biases were towards the barley for all but 1 subject (Holly) in the 0% salt conditions, and for all but 2 subjects (George and Holly) in the 2% salt conditions, while in the 4% and 6% salt conditions, all subjects' post-COD biases were towards the barley. In most cases, the post-COD bias estimates were more variable than the within-COD bias estimates.

The overall within- and post-COD biases are presented in Table 4.2. In all but one case, the post-COD biases were greater than the within-COD biases. In general, the within-COD biases were small, with no systematic changes with increases in salt concentration. The mean overall post-COD biases show that bias

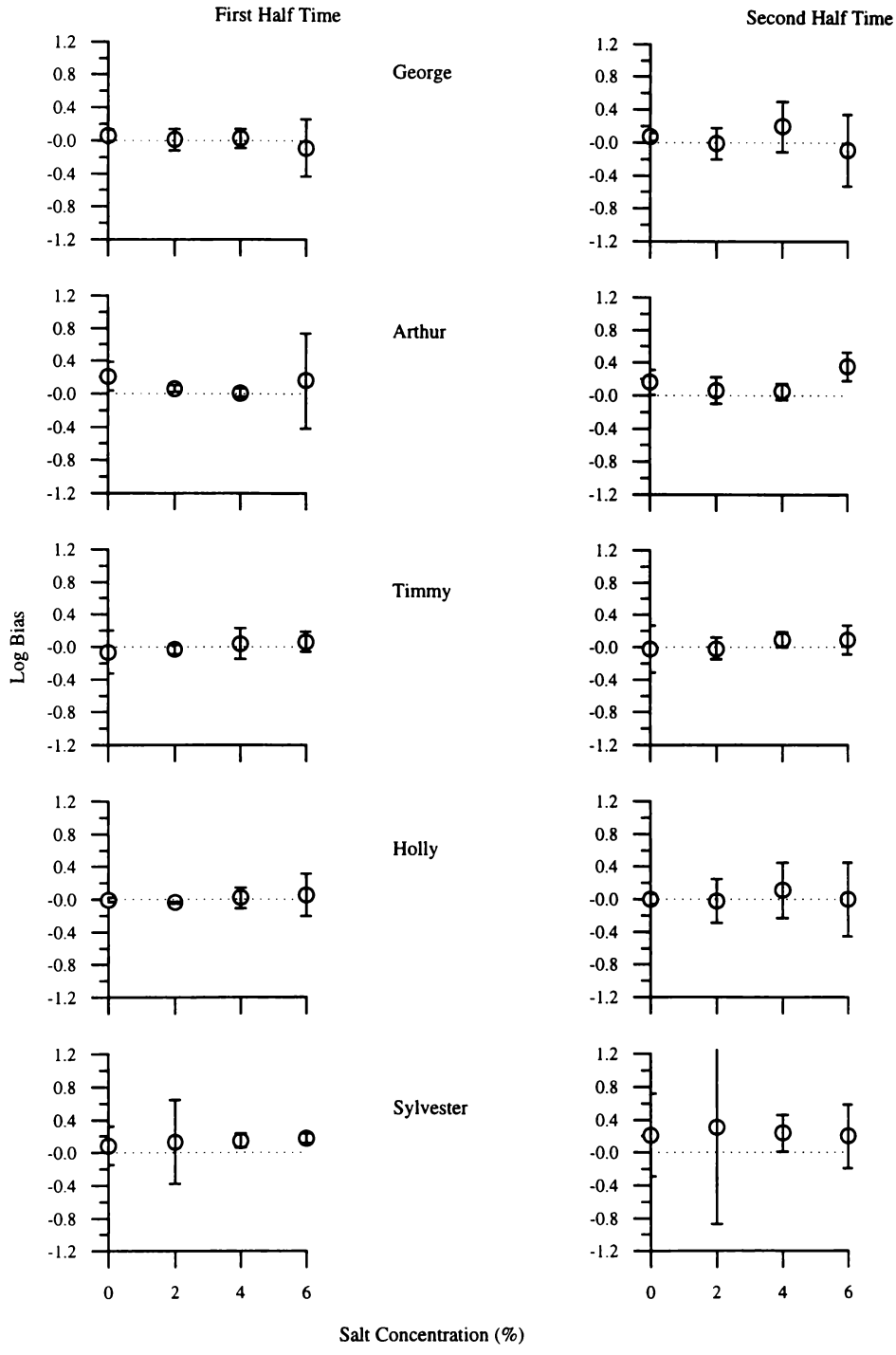


Figure 4.3. The point estimates of bias for each possum based on the first and second half time data for each of the salt concentrations paired with the crushed barley/carob mixture and equal concurrent VI VI schedules of reinforcement.

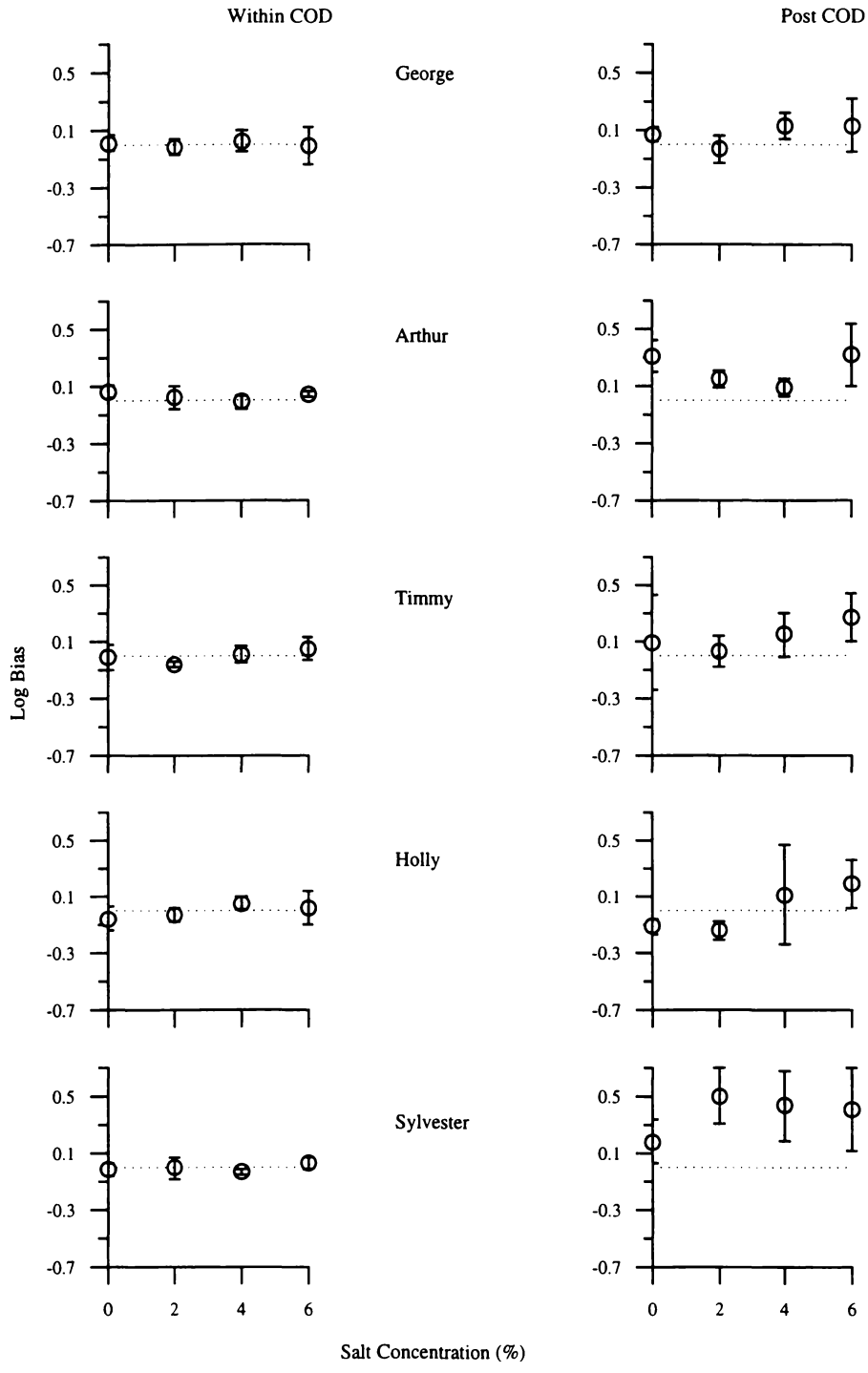


Figure 4.4. The point estimates of bias for each possum based on the within- and post-COD data for each of the salt concentrations paired with the crushed barley/carob mixture and equal concurrent VI VI schedules of reinforcement.

increased (in the direction of barley) as the concentration of salt increased (from 0% up to 6%). However, this was not the case for the individual data from any subject.

Figure 4.5 shows the logarithms of the point estimates of bias for the PRP-time (left panel) and net-time ratios (right panel) plotted against salt concentration. The PRP-time biases were generally smaller than the net-time biases. Neither bias measure changed consistently with changes in salt concentration. The PRP-time biases were idiosyncratic, with no consistencies either between or within subjects. The net-time biases were more consistent across subjects.

The net-time allocation biases were towards the barley for all but 1 subject in the 0% salt condition. The remaining subject (Holly) showed no net-time allocation bias. When 2% salt was presented, all but 1 subject was biased towards the barley, the exception being Holly. In the 4% salt conditions, all subjects' net-time allocation was biased towards the barley, and in the 6% salt conditions, all but 1 subjects' (George) net-time biases were towards the barley. There were no consistent differences in the variability of the PRP- and net-time bias estimates.

The overall net-time allocation and PRP-time allocation biases are presented in Table 4.2. In most cases, the net-time biases were greater than the PRP-time biases. The PRP-time biases were less variable than the net-time allocation biases, however, in both cases, there were no systematic changes in bias as the salt concentration was increased.

Since the reinforcement rate was held constant during Conditions 1 to 10, as in Experiment 3, the number of changeovers made per minute are plotted against the logarithms of the time-allocation ratios (left panel) and the logarithms of the response ratios (right panel) in Figure 4.6 for each possum. The data from all subjects failed to conform to the inverted U-shaped function normally found when changeover rate is plotted against these measures. The maximum rate of changing over only occurred at a log ratio of approximately 0.0 for 1 subject (Arthur) with both response and time allocation. No other patterns were evident.

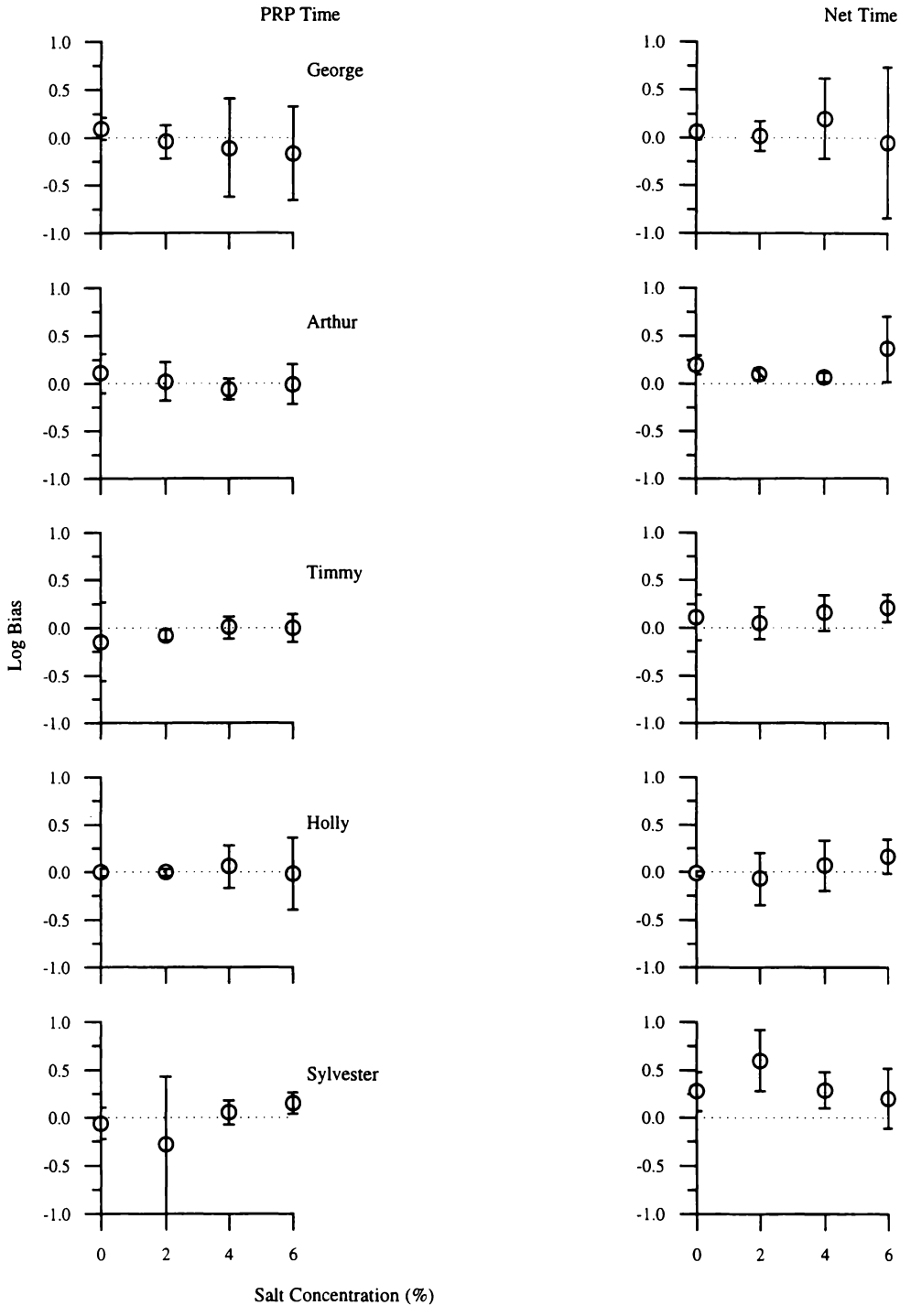


Figure 4.5. The point estimates of bias for each possum based on the PRP and net time data for each of the salt concentrations paired with the crushed barley/carob mixture and equal concurrent VI VI schedules of reinforcement.

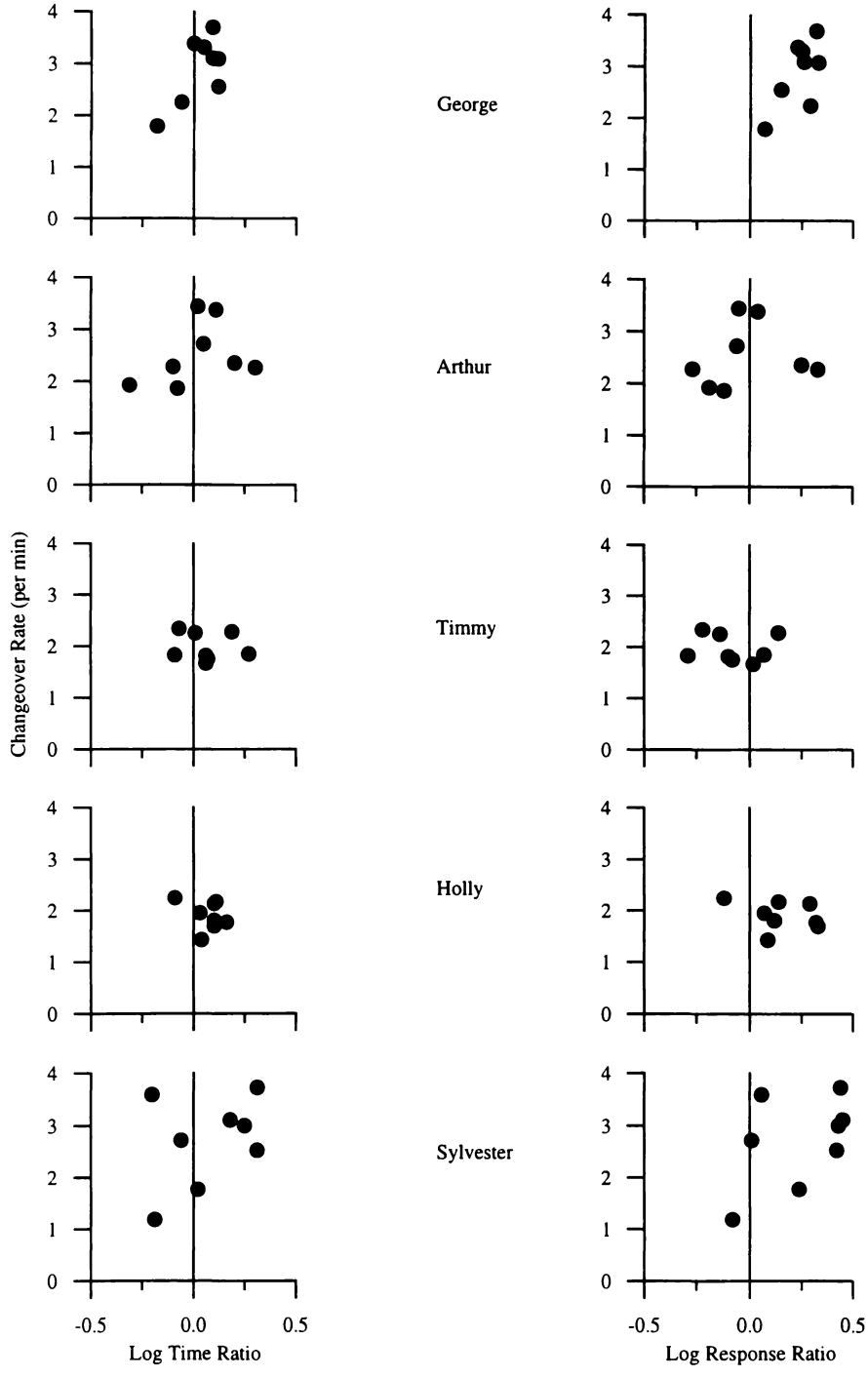


Figure 4.6. The rate of changing over per minute plotted against the logarithms of the time allocation ratios and the logarithms of the response allocation ratios for each possum, with equal concurrent VI VI schedules.

Figure 4.7 shows the absolute rates of responding, averaged over the last five sessions of each condition, on both the left (left panel) and right (right panel) levers, plotted against salt concentration for each possum. The unfilled circles represent the data from the conditions in which the salted alternative was associated with that lever, while the pluses represent the data from the conditions in which the barley was associated with that lever. In most cases (28 of 40), the rate of responding on a lever was faster when that lever was associated with the alternative that was preferred overall (based on responding over the two conditions in which each salt concentration was presented). For example, when 6% salt was presented for responses on the left lever, responding was slower than when barley was presented for responses on that lever (with 6% salt associated with the other lever). It would not be expected that the absolute response rates be faster on the alternative that was preferred overall in all cases, because bias was not always consistently towards that alternative across the two conditions. The absolute rates of responding did not appear to change systematically with salt concentration.

The local rates of responding, averaged over the last five sessions of each condition, are plotted against salt concentration for both the left (left panel) and right (right panel) levers in Figure 4.8 for all subjects. The unfilled circles represent the conditions where the salted alternative was associated with that lever, while the pluses represent the conditions where the barley was associated with that lever. There appears to be no systematic relationship between the local response rates and bias. Unlike the absolute rates of responding, there was no tendency for faster responding on either alternative. As with the absolute response rates, there was no obvious relationship between the local response rates and salt concentration.

Line Estimates of Bias

Figure 4.9 shows the logarithms of the response ratios plotted against the logarithms of the obtained reinforcer-rate ratios for the 4% (centre panel) and 6% (right panel) salt conditions in which the reinforcer-rate ratio was not equal to zero

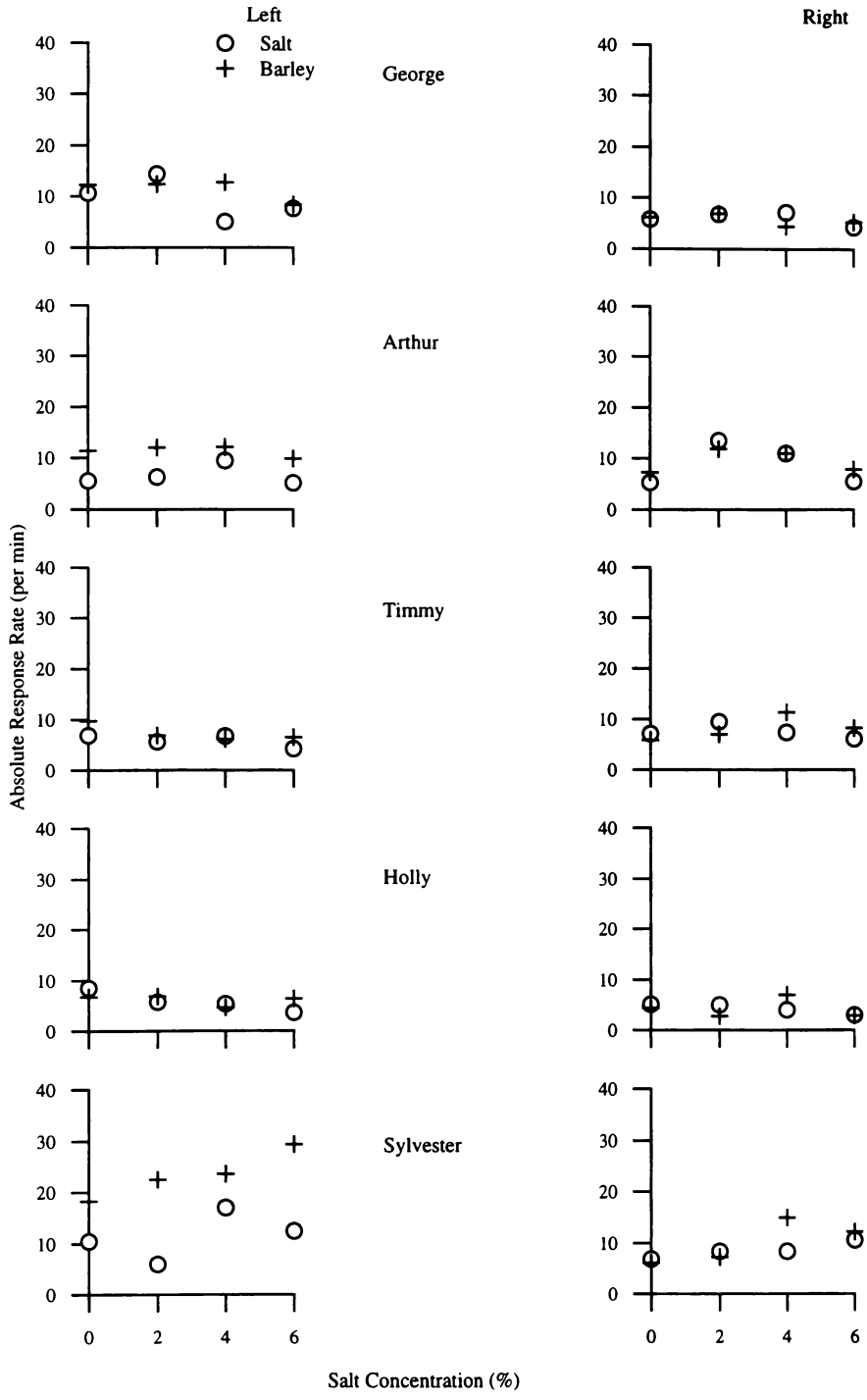


Figure 4.7. The absolute rate of responding per minute on the left and right levers, plotted separately for conditions when the salted alternative and the barley alternative were associated with that lever, for each possum at each salt concentration, when equal concurrent VI VI schedules were used.

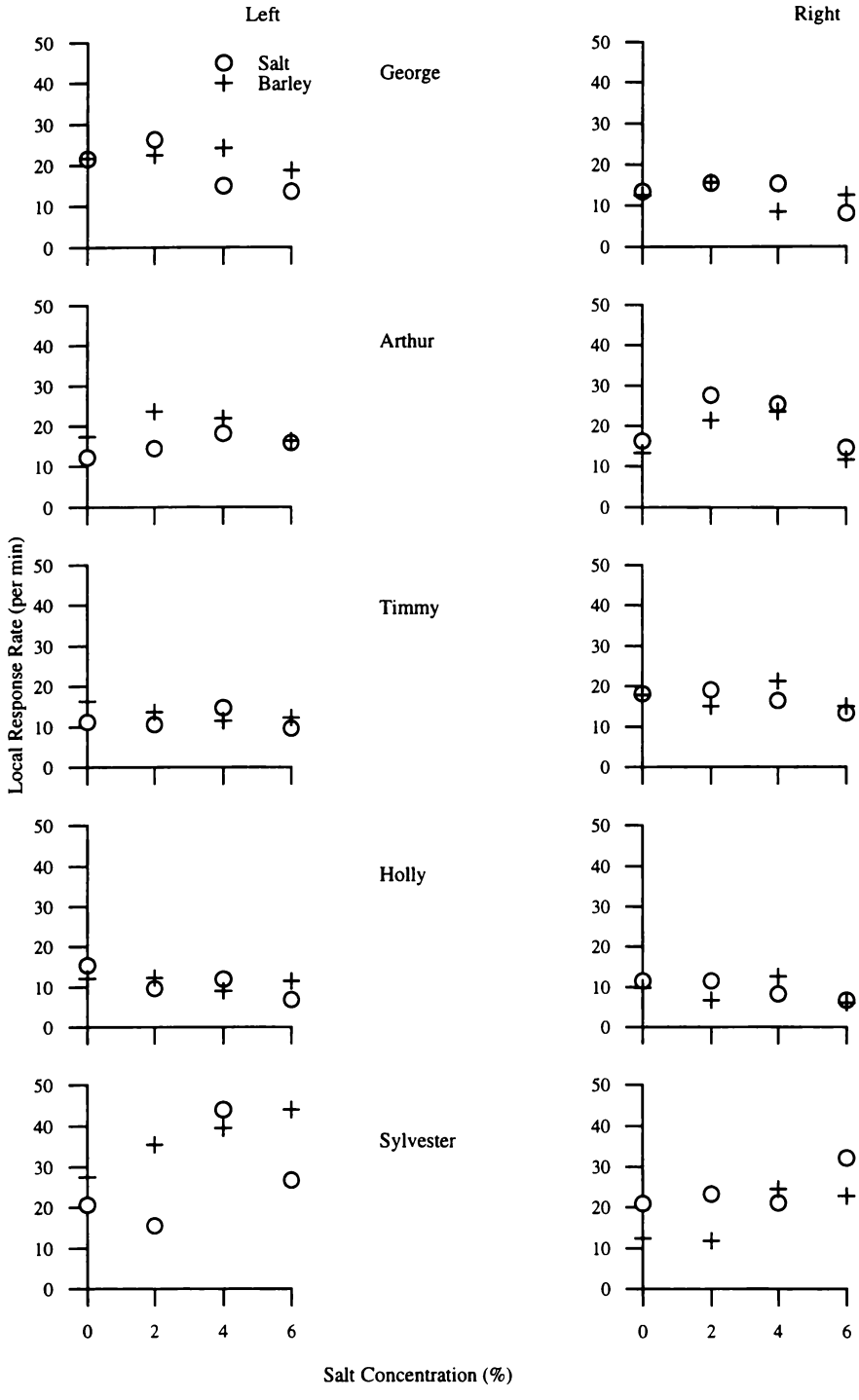


Figure 4.8. The local rate of responding per minute on the left and right levers, plotted separately for conditions when the salted alternative and the barley alternative were associated with that lever, for each possum at each salt concentration, when equal concurrent VI VI schedules were used.

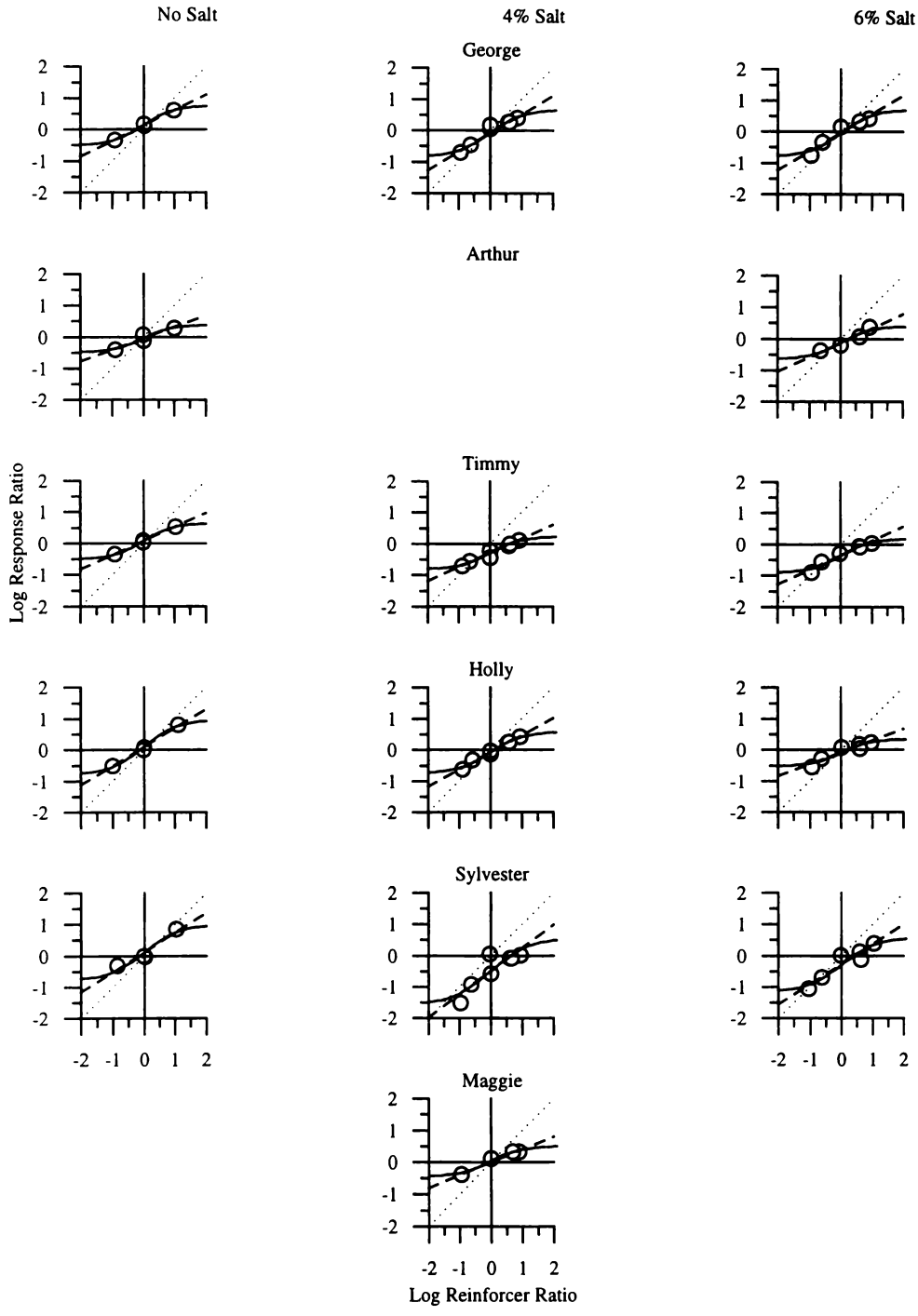


Figure 4.9. The logarithms of the response ratios for the No Salt, 4% Salt and 6% Salt conditions in which the VI schedules were varied, plotted against the logarithm of the obtained reinforcer rate ratio for all possums. The dashed line was fitted by the method of least squares to the data and the dotted line represents perfect matching. The solid line represents the function generated by the fit of the Contingency-Discriminability model the data using non-linear regression.

(as well as Conditions 8 and 21 (4%) and 10 (6%), where the schedules were equal). For comparison, the logarithms of the response ratios from Experiment 1, where the reinforcer-rate ratio was varied with only one food magazine (left panel) are also presented.

The dotted line presented on each graph has a slope of 1.0 and an intercept of zero (strict matching). The dashed line is the line of best fit (matching line), calculated using least-squares linear regression, and the solid line is the line obtained when the C-D model was fitted to the data using least-squares non-linear regression. The data obtained from the two equal schedules conditions conducted with 4% salt (Conditions 8 and 21) were similar for all but 1 subject (Sylvester), indicating that this condition was generally well replicated. The graphs show that the lines obtained using the GML and the C-D model are very similar over the range of reinforcer ratios used and, in fact, appear to be superimposed over most of this range, with the C-D model predicting less extreme behaviour than the GML beyond this range. This indicates that the biases measured by the two equations should be very similar. Tables 4.3 and 4.4 give the values of $a$ and log $c$ calculated using a GML analysis, as well as the percentages of variance accounted for (%VAC) by the lines, and the standard errors of the estimates (SE) for the 4% and 6% salt conditions respectively. Table 4.5 gives the values of $d_r$ and log $c$ as well as the %VAC by the lines obtained using the C-D model for the 4% and 6% salt conditions.

The mean %VAC measures were high with both models, but were slightly higher in the case of the GML analysis with both salt concentrations (95% vs. 93% for 4% salt; 92% vs. 91% for 6% salt). The standard errors of the estimates obtained using the GML were generally low, ranging from 0.04 to 0.33 in the 4% salt conditions, and from 0.08 to 0.20 in the 6% salt conditions. There were no consistent changes in slope ($a$ values) with changes in salt concentration. The mean values of $a$ were 0.51, 0.55 and 0.51 for the no salt, 4% salt and 6% salt conditions respectively. Similarly, there were no consistent changes in $d_r$ with changes in salt concentration (no salt: $d_r = 5.01$; 4% salt: $d_r = 5.40$; 6% salt: $d_r = 4.43$).

Table 4.3
Slopes ($a$), y-intercepts (log $c$), the percentage of variance accounted for (%VAC) and standard errors of the estimates (SE) for the lines of best fit for total response (Figure 4.9) and time allocation (Figure 4.10), within- and post-COD responding (Figure 4.11), first and second half response and time allocation, and PRP and net time allocation (Figure 4.12) when 4% salt was presented.

| Possum | Slope ($a$) | ntercept (log $c$) | %VAC | SE | Slope (a) | ntercept (log $c$) | %VAC | SE |
|---|---|---|---|---|---|---|---|---|
| | Total Responses | | | | Total Time | | | |
| George | 0.60 | -0.08 | 97.42 | 0.08 | 0.82 | -0.11 | 96.11 | 0.14 |
| Maggie | 0.40 | 0.00 | 99.08 | 0.05 | 0.90 | 0.22 | 93.91 | 0.33 |
| Timmy | 0.45 | -0.29 | 98.97 | 0.04 | 0.86 | -0.21 | 94.31 | 0.17 |
| Holly | 0.55 | -0.08 | 98.56 | 0.05 | 0.77 | -0.20 | 91.48 | 0.19 |
| Sylvest | 0.74 | -0.50 | 78.52 | 0.33 | 1.07 | -0.32 | 98.34 | 0.12 |
| MEAN | 0.55 | -0.19 | 94.51 | 0.11 | 0.88 | -0.12 | 94.83 | 0.19 |
| | First Half Responses | | | | Second Half Responses | | | |
| George | 0.61 | -0.08 | 96.50 | 0.10 | 0.58 | -0.08 | 95.18 | 0.11 |
| Maggie | 0.40 | 0.05 | 99.89 | 0.02 | 0.48 | -0.05 | 85.30 | 0.29 |
| Timmy | 0.40 | -0.31 | 98.53 | 0.04 | 0.49 | -0.26 | 98.51 | 0.05 |
| Holly | 0.52 | -0.06 | 97.31 | 0.07 | 0.60 | -0.14 | 98.53 | 0.06 |
| Sylvest | 0.77 | -0.48 | 76.08 | 0.36 | 0.68 | -0.53 | 80.52 | 0.30 |
| MEAN | 0.54 | -0.18 | 93.66 | 0.12 | 0.57 | -0.21 | 91.61 | 0.16 |
| | First Half Time | | | | Second Half Time | | | |
| George | 0.85 | -0.17 | 98.17 | 0.10 | 0.80 | -0.07 | 88.10 | 0.24 |
| Maggie | 0.95 | 0.03 | 98.59 | 0.16 | 1.06 | 0.46 | 77.19 | 0.82 |
| Timmy | 0.93 | -0.36 | 96.92 | 0.15 | 0.85 | -0.11 | 89.97 | 0.22 |
| Holly | 0.79 | -0.19 | 94.94 | 0.15 | 0.77 | -0.20 | 86.63 | 0.24 |
| Sylvest | 0.97 | -0.30 | 96.91 | 0.15 | 1.15 | -0.32 | 98.61 | 0.12 |
| MEAN | 0.90 | -0.20 | 97.10 | 0.14 | 0.93 | -0.05 | 88.10 | 0.33 |
| | Within COD | | | | Post COD | | | |
| George | 0.05 | 0.19 | 13.69 | 0.10 | 0.82 | -0.19 | 99.08 | 0.07 |
| Maggie | -0.02 | 0.12 | 22.71 | 0.04 | 0.79 | -0.01 | 96.90 | 0.20 |
| Timmy | 0.00 | -0.21 | 1.01 | 0.03 | 0.74 | -0.34 | 99.68 | 0.03 |
| Holly | -0.06 | 0.05 | 28.33 | 0.08 | 0.90 | -0.16 | 98.21 | 0.10 |
| Sylvest | -0.06 | -0.02 | 5.19 | 0.22 | 1.08 | -0.72 | 92.49 | 0.26 |
| MEAN | -0.02 | 0.02 | 14.19 | 0.09 | 0.87 | -0.28 | 97.27 | 0.13 |
| | PRP Time | | | | Net Time | | | |
| George | 1.02 | -0.06 | 95.56 | 0.18 | 0.73 | -0.14 | 94.37 | 0.15 |
| Maggie | 0.95 | 0.14 | 99.95 | 0.03 | 0.85 | 0.23 | 75.94 | 0.68 |
| Timmy | 1.02 | -0.12 | 91.09 | 0.26 | 0.67 | -0.32 | 94.93 | 0.13 |
| Holly | 0.76 | -0.29 | 88.70 | 0.22 | 0.92 | 0.07 | 97.61 | 0.12 |
| Sylvest | 1.00 | -0.17 | 98.63 | 0.10 | 1.13 | -0.43 | 96.61 | 0.18 |
| MEAN | 0.95 | -0.10 | 94.79 | 0.16 | 0.86 | -0.12 | 91.89 | 0.25 |

Table 4.4
Slopes ($a$), y-intercepts (log $c$), the percentage of variance accounted for (%VAC) and standard errors of the estimates (SE) for the lines of best fit for total response (Figure 4.9) and time allocation (Figure 4.10), within and post COD responding (Figure 4.11), first and second half response and time allocation, and PRP and net time allocation (Figure 4.12) when 6% salt was presented.

| Possum | Slope ($a$) | ntercept (log $c$) | %VAC | SE | Slope ($a$) | ntercept (log $c$) | %VAC | SE |
|---|---|---|---|---|---|---|---|---|
| | Total Responses | | | | Total Time | | | |
| George | 0.60 | -0.04 | 93.46 | 0.13 | 0.89 | -0.16 | 95.58 | 0.16 |
| Arthur | 0.45 | -0.13 | 94.35 | 0.09 | 0.65 | -0.15 | 93.21 | 0.15 |
| Timmy | 0.46 | -0.35 | 95.95 | 0.08 | 0.98 | -0.30 | 95.64 | 0.18 |
| Holly | 0.38 | -0.08 | 88.08 | 0.12 | 0.76 | -0.16 | 95.88 | 0.13 |
| Sylvest | 0.64 | -0.28 | 89.35 | 0.20 | 1.13 | -0.26 | 93.06 | 0.28 |
| MEAN | 0.51 | -0.18 | 92.24 | 0.12 | 0.88 | -0.21 | 94.67 | 0.18 |
| | First Half Responses | | | | Second Half Responses | | | |
| George | 0.60 | -0.06 | 94.96 | 0.12 | 0.60 | -0.02 | 91.45 | 0.15 |
| Arthur | 0.37 | -0.11 | 88.53 | 0.12 | 0.54 | -0.15 | 97.38 | 0.07 |
| Timmy | 0.47 | -0.36 | 97.74 | 0.07 | 0.45 | -0.34 | 92.83 | 0.10 |
| Holly | 0.37 | -0.05 | 89.76 | 0.11 | 0.38 | -0.15 | 79.36 | 0.16 |
| Sylvest | 0.65 | -0.25 | 89.49 | 0.20 | 0.59 | -0.36 | 81.15 | 0.24 |
| MEAN | 0.49 | -0.17 | 92.10 | 0.12 | 0.51 | -0.20 | 88.44 | 0.15 |
| | First Half Time | | | | Second Half Time | | | |
| George | 0.89 | -0.18 | 95.74 | 0.16 | 0.89 | -0.14 | 94.08 | 0.18 |
| Arthur | 0.72 | -0.10 | 96.05 | 0.13 | 0.59 | -0.18 | 84.25 | 0.22 |
| Timmy | 0.95 | -0.35 | 94.80 | 0.20 | 1.03 | -0.27 | 95.91 | 0.17 |
| Holly | 0.82 | -0.19 | 95.75 | 0.15 | 0.73 | -0.12 | 94.10 | 0.15 |
| Sylvest | 0.96 | -0.24 | 96.57 | 0.16 | 1.24 | -0.46 | 84.08 | 0.46 |
| MEAN | 0.87 | -0.21 | 95.78 | 0.16 | 0.90 | -0.23 | 90.48 | 0.24 |
| | Within COD | | | | Post COD | | | |
| George | 0.06 | 0.26 | 66.94 | 0.03 | 0.89 | -0.20 | 95.78 | 0.16 |
| Arthur | -0.01 | 0.11 | 5.40 | 0.03 | 0.65 | -0.24 | 94.13 | 0.14 |
| Timmy | 0.02 | -0.22 | 4.56 | 0.09 | 0.87 | -0.50 | 96.96 | 0.13 |
| Holly | -0.02 | 0.12 | 5.97 | 0.05 | 0.61 | -0.20 | 93.18 | 0.14 |
| Sylvest | 0.09 | 0.21 | 25.71 | 0.14 | 1.05 | -0.69 | 94.25 | 0.23 |
| MEAN | 0.03 | 0.10 | 21.71 | 0.07 | 0.81 | -0.37 | 94.86 | 0.16 |
| | PRP Time | | | | Net Time | | | |
| George | 1.07 | -0.11 | 94.44 | 0.22 | 0.85 | -0.17 | 96.26 | 0.14 |
| Arthur | 0.77 | 0.14 | 93.58 | 0.17 | 0.65 | -0.26 | 83.94 | 0.24 |
| Timmy | 1.39 | -0.32 | 90.28 | 0.39 | 0.74 | -0.42 | 92.05 | 0.19 |
| Holly | 0.80 | -0.14 | 91.11 | 0.21 | 0.69 | -0.18 | 87.49 | 0.22 |
| Sylvest | 1.12 | -0.16 | 95.23 | 0.23 | 1.14 | -0.34 | 90.40 | 0.33 |
| MEAN | 1.03 | -0.12 | 92.93 | 0.24 | 0.81 | -0.28 | 90.03 | 0.22 |

Table 4.5

Estimates of relative discriminability ($p_r$), discriminability ($d_r$), bias ($\log c$), and the percentage of variance accounted for (%VAC) for the lines of best fit for response- (Figure 4.9) and time-allocation (Figure 4.10) and post-COD responding (Figure 4.11) when 4% and 6% salt were presented.

| | 4% Salt | | | | 6% Salt | | | |
|---|---|---|---|---|---|---|---|---|
| Possum | $p_r$ | $d_r$ | $\log c$ | %VAC | $p_r$ | $d_r$ | $\log c$ | %VAC |
| | | | | Responses | | | | |
| George | 0.85 | 5.56 | -0.08 | 96.87 | 0.85 | 5.62 | -0.04 | 92.32 |
| Maggie | 0.75 | 2.93 | 0.03 | 96.03 | 0.77 | 3.26 | -0.12 | 91.13 |
| Timmy | 0.77 | 3.30 | -0.29 | 98.33 | 0.78 | 3.51 | -0.36 | 95.12 |
| Holly | 0.82 | 4.55 | -0.08 | 97.78 | 0.73 | 2.71 | -0.09 | 86.69 |
| Sylvester | 0.91 | 10.65 | -0.50 | 77.71 | 0.88 | 7.05 | -0.29 | 87.65 |
| MEAN | 0.82 | 5.40 | -0.19 | 93.34 | 0.80 | 4.43 | -0.18 | 90.58 |
| | | | | Post COD responses | | | | |
| George | 0.94 | 16.01 | -0.19 | 99.28 | 0.97 | 30.47 | -0.20 | 95.63 |
| Maggie | 0.92 | 12.32 | 0.04 | 94.47 | 0.87 | 6.61 | -0.23 | 91.82 |
| Timmy | 0.91 | 10.13 | -0.34 | 99.66 | 0.96 | 25.35 | -0.50 | 96.91 |
| Holly | 0.97 | 29.68 | -0.16 | 98.27 | 0.85 | 5.87 | -0.21 | 92.87 |
| Sylvester | 1.02 | -46.69 | -0.72 | 92.61 | 1.02 | -64.38 | -0.69 | 94.46 |
| MEAN | 0.95 | 4.29 | -0.27 | 96.86 | 0.93 | 0.78 | -0.37 | 94.34 |
| | | | | Time | | | | |
| George | 0.94 | 15.19 | -0.11 | 96.66 | 0.97 | 33.09 | -0.17 | 95.29 |
| Maggie | 0.97 | 27.82 | 0.26 | 93.19 | 0.87 | 6.66 | -0.14 | 93.66 |
| Timmy | 0.95 | 19.16 | -0.21 | 94.66 | 0.99 | 115.37 | -0.30 | 95.68 |
| Holly | 0.92 | 11.35 | -0.20 | 91.56 | 0.92 | 11.71 | -0.16 | 95.60 |
| Sylvester | 1.02 | -54.12 | -0.32 | 98.38 | 1.04 | -24.54 | -0.26 | 95.01 |
| MEAN | 0.96 | 3.88 | -0.12 | 94.89 | 0.96 | 28.46 | -0.21 | 95.05 |

While all subjects' response biases were towards barley when 4% and 6% salt were presented in the alternative magazine, there were no consistent changes in bias across these conditions. Generally, the biases observed in these conditions were greater than those obtained in Experiment 1 with only one food (mean bias estimates: 0.07, no salt; -0.19, 4% salt; -0.18 6% salt). There was very little difference between the bias estimates obtained with the GML and those obtained when the C-D model was used. The mean values of log *c* obtained with the C-D model were identical to those presented above.

The logarithms of the time ratios are plotted against the logarithms of the obtained reinforcer-rate ratios for Experiment 1 (no salt; left panel), the 4% salt conditions, and the 6% salt conditions (as in Figure 4.9, centre and right panels respectively) in Figure 4.10. As in Figure 4.9, the dashed line present on each graph is the matching line, calculated using least-squares linear regression, the solid line was obtained using non-linear regression with the C-D model, while the dotted line represents strict matching. The data obtained from the two equal schedules conditions conducted with 4% salt (Conditions 8 and 21) were similar for all subjects, again indicating that this condition replicated well. Again, the lines obtained using the GML and the C-D model are very similar over the range of reinforcer-rate ratios used. However, for 1 subject (Sylvester), the C-D model predicts more extreme time allocation outside of this range. This only occurs in cases where 'overmatching' was found with the GML. Nevertheless, the bias estimates obtained with the two models should again be very similar, as both lines appear to cross the y-axis in approximately the same place. The values of *a* and log *c* (calculated using a GML analysis), as well as the %VAC and SE measures for the 4% and 6% salt conditions, are presented in Tables 4.3 and 4.4 respectively. The values of $d_r$, log *c*, and the %VAC measures obtained using the C-D model are presented in Table 4.5 for the 4% and 6% salt conditions.

The %VAC measures were high for both models. There were very little differences between the mean %VAC from the two models, with the C-D model giving slightly higher measures in both cases (94.8% vs. 94.9% with 4% salt; 94.7% vs. 95.1% with 6% salt). This result is opposite to that observed with the

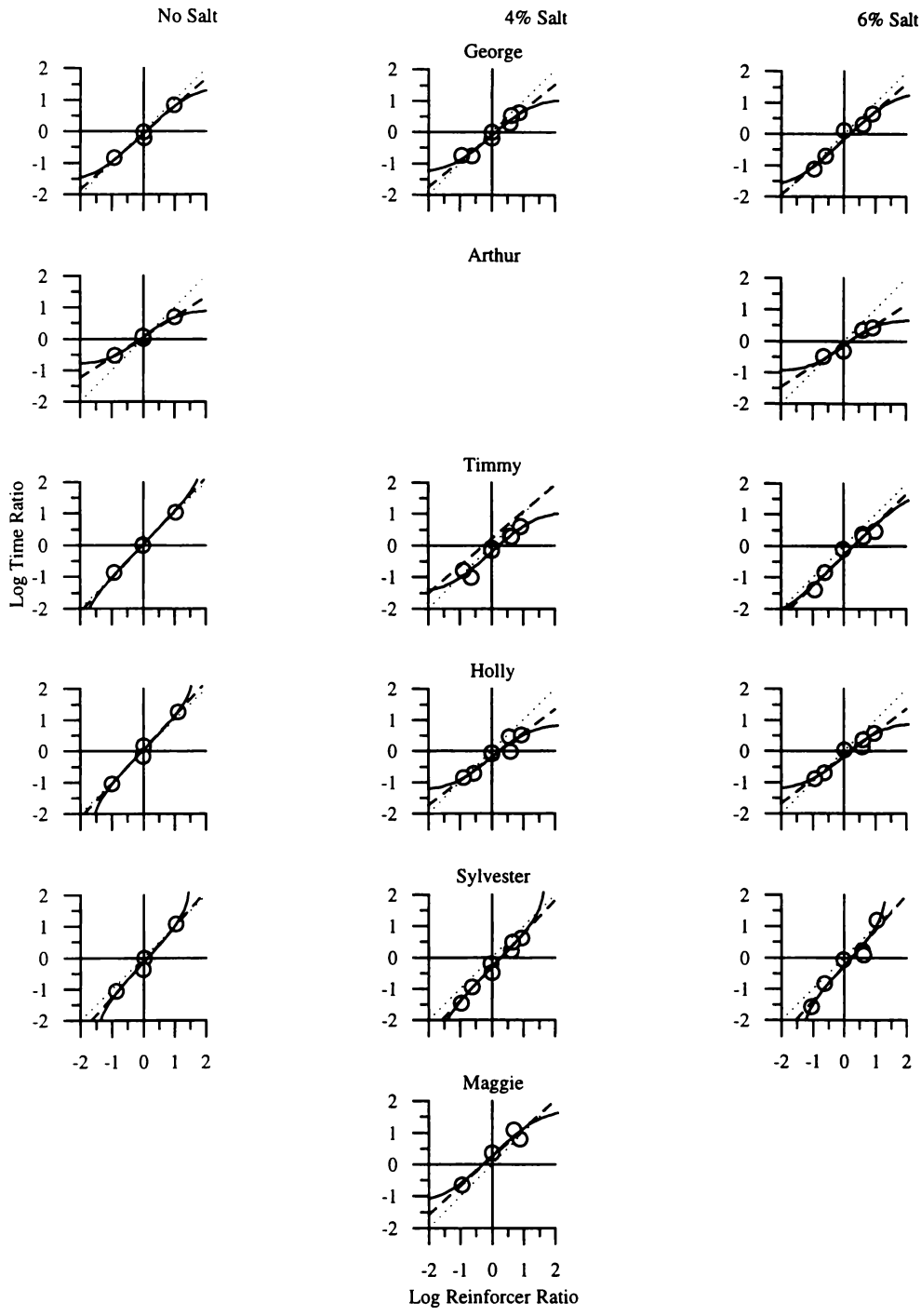


Figure 4.10. The logarithms of the time ratios for the No Salt, 4% Salt and 6% Salt conditions in which the VI schedules were varied, plotted against the logarithm of the obtained reinforcer rate ratio for all possums. The dashed line was fitted by the method of least squares to the data and the dotted line represents perfect matching. The solid line represents the function generated by the fit of the Contingency-Discriminability model the data using non-linear regression.

response measures. The standard errors of the estimates were low for both the 4% and 6% salt conditions, ranging from 0.12 to 0.33. As was the case with the response measures, there were no consistent changes in the values of either *a* (mean values of 0.96 with no salt; 0.88 with both 4% and 6% salt) or $d_r$ (mean values of –25.55 with no salt, 3.88 with 4% salt, and 28.46 with 6% salt) with changes in salt concentration. All but 1 subjects' (Maggie; 4% salt) time-allocation measures were biased towards the barley when both 4% and 6% salt were presented. Although the mean time-allocation bias measure was greater for the 6% salt conditions than the 4% salt conditions (-0.21 vs. –0.12), there were no consistent changes across salt concentrations. The mean values of log *c* obtained using the two models were identical for both salt concentrations.

The logarithms of the ratios of responses made after the COD are plotted against the logarithms of the obtained reinforcer ratios in Figure 4.11. The left panel shows the data from Experiment 1, where only one magazine was used, with no salt added. The centre and right panels show the data from the 4% and 6% salt conditions (as in Figure 4.9), respectively. The dashed, dotted and solid lines represent the matching line obtained from the data, strict matching, and the line of best fit from the C-D model, respectively.

The lines obtained from the GML and C-D analyses are again superimposed over the range of reinforcer-rate ratios presented. The post-COD data are more similar to the total time data than to the total response data. As was seen with the time-allocation data, the C-D model predicts more extreme responding at reinforcer-rate ratios outside the range presented for Sylvester at all salt concentrations (accompanied by *a* values greater than 1.0). The values of *a*, log *c*, %VAC and SE are presented in Tables 4.3 and 4.4 for the 4% and 6% salt conditions respectively. Although not presented graphically, the parameters are also given for responding within the COD. Table 4.5 gives the values of $p_r$, $d_r$, log *c* and %VAC for the post-COD data from the 4% and 6% salt conditions. From this table it can be seen that the values of *a*, $d_r$ and log *c* did not change consistently with changes in salt concentration for either within- or post-COD responding. While in Experiment 1, the within-COD biases were generally larger

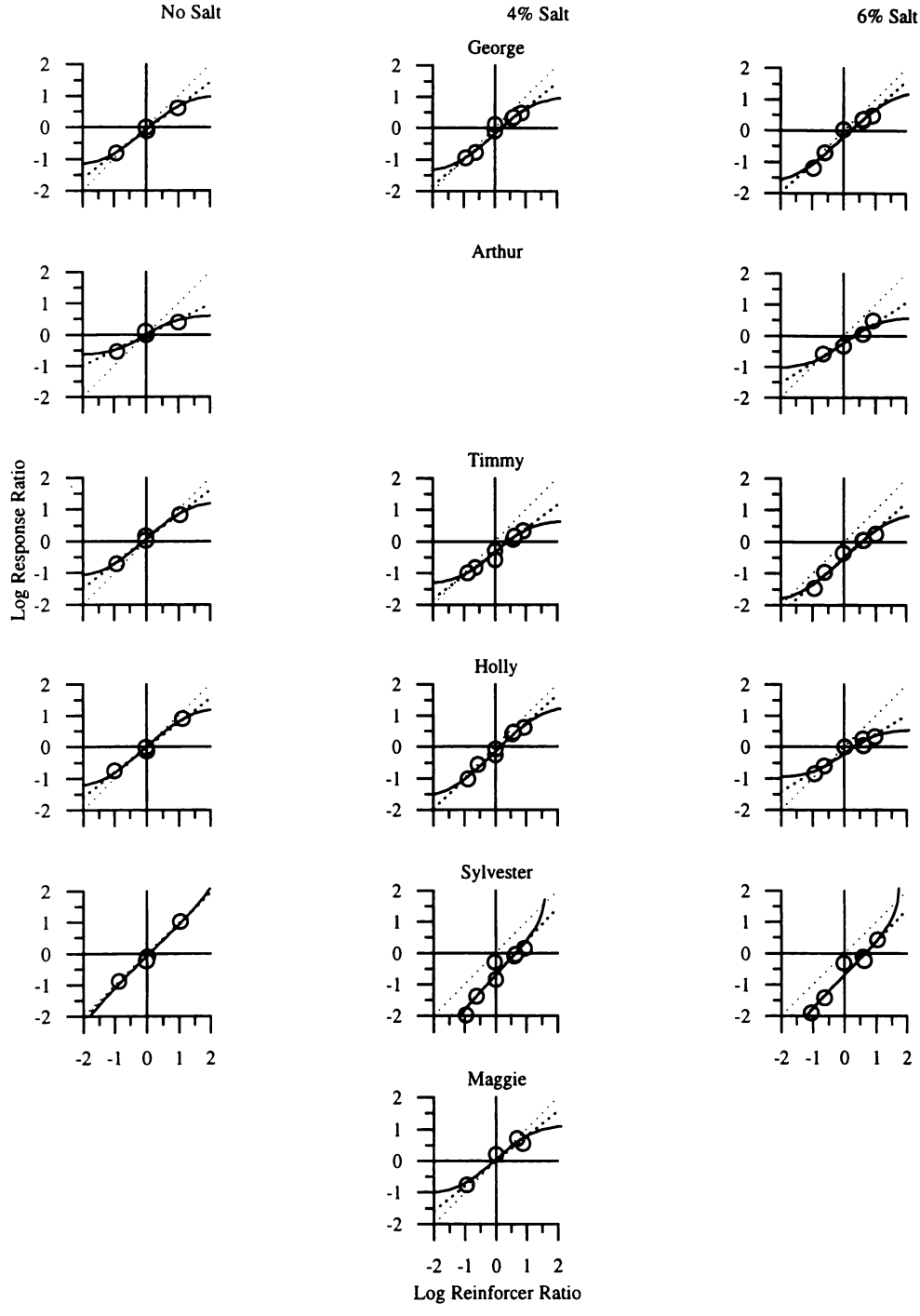


Figure 4.11. The logarithms of the post-COD response ratios for the No Salt, 4% Salt and 6% Salt conditions in which the VI schedules were varied, plotted against the logarithm of the obtained reinforcer rate ratio for all possums. The dashed line was fitted by the method of least squares to the data and the dotted line represents perfect matching. The solid line represents the function generated by the fit of the Contingency-Discriminability model the data using non-linear regression.

than the post-COD biases, the opposite is true for the data from the 4% and 6% salt conditions.

Figure 4.12 shows the logarithms of the post-reinforcement-pause (PRP) time ratios and the net-time-allocation ratios plotted against the logarithms of the obtained reinforcement-rate ratios for the 4% salt conditions (centre panel), the 6% salt conditions (right panel) and the no-salt conditions from Experiment 1 (left panel). The dashed and solid lines presented on each graph represent the matching lines obtained from the PRP- and net-time allocation data respectively. No analyses were carried out using the C-D model here.

In most cases (10 out of 15), the line obtained from the PRP-time-allocation data is steeper than that obtained from the net-time-allocation data. In addition, the slope of the line describing PRP-time-allocation data is generally closer to 1.0 than the line describing net-time allocation (11 out of 15 cases). There were no consistent changes in the slopes obtained using either measure with changes in salt concentration. Generally, there was more bias observed in the net-time-allocation data than in the PRP-time-allocation data. While there were no consistent changes in the PRP-time bias measures across salt concentrations for all but 1 subject (the exception being Timmy, whose bias away from the salt increased with increases in concentration), the net-time-allocation bias measures towards barley increased for 2 subjects (George and Timmy), and decreased for 1 subject (Sylvester), as the concentration of salt was increased.

Tables 4.3 and 4.4 give the values of $a$, log $c$, %VAC and SE for the PRP-time and net-time-allocation data from the 4% and 6% salt conditions, respectively. There were no consistent changes in the values of either $a$ or log $c$ for either PRP- or net-time allocation as the salt concentration was increased from no salt to 6% salt. While the $a$ values obtained from the PRP-time data increased from the 4% to the 6% salt conditions for all 4 subjects who completed both sets of conditions, there were no consistent differences between the values obtained from the no salt conditions and those obtained from either the 4% or the 6% salt conditions.

The changeover rates from conditions where the schedules were unequal

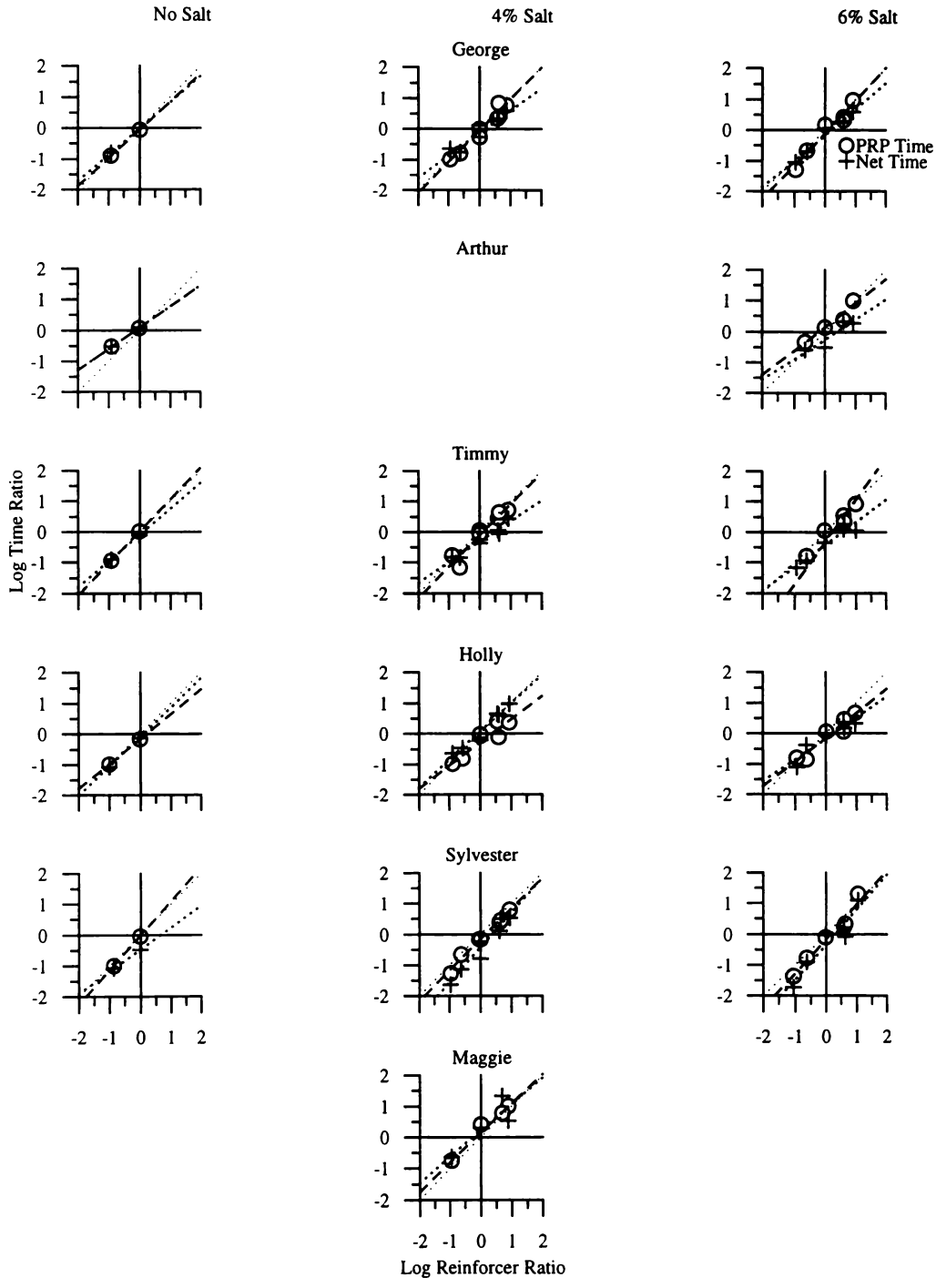


Figure 4.12. The logarithms of the PRP and net time ratios for the No Salt, 4% Salt and 6% Salt conditions in which the VI schedules were varied, plotted against the logarithm of the obtained reinforcer rate ratio for all possums. The dashed line was fitted by the method of least squares to the data and the dotted line represents perfect matching.

are not presented here. Analysis of these data indicated that the pattern of CO rates plotted against the log reinforcer, log response, and log time ratios was similar to that observed with the data from the equal-schedule conditions presented previously (Figure 4.6). In those conditions, the inverted U-shaped function which has been found when CO rate is plotted against the logarithms of the time- and response-allocation ratios was not present.

The local and absolute rates of responding on the left lever (unfilled circles) and right lever (pluses) are plotted against the logarithms of the reinforcer ratios for each possum in Figures 4.13 and 4.14, respectively. The left panels show the data obtained in Experiment 1 (where no salt was added to the barley), the centre panels show the data from the 4% salt conditions used in the matching line analyses above, and the right panels show the data from the corresponding 6% salt conditions. The local rates of responding on a lever tended to decrease as the reinforcer rate on that lever increased. The local response rates were faster in the no salt conditions, with very little difference between the rates observed during the 4% and 6% salt conditions. The absolute rates of responding tended to be fastest on the lever associated with the rich alternative (i.e., response rates on a particular lever increased as the reinforcer rate on that lever increased). For 3 subjects (Arthur, Timmy and Holly), the absolute response rates were faster during the no-salt conditions, and for 1 subject (Sylvester) the absolute response rates were highest during the 6% salt conditions. In all other cases, the differences between the absolute response rates across salt concentrations were very small.

Point Estimates vs. Line Estimates

In order to compare the point estimates of bias to the estimates obtained from the GML analysis, it is first necessary to remove inherent bias from the estimate. This can be done by subtracting the values of log *c* (inherent bias) obtained in Experiment 1 from the values of log *c* (from line estimates) obtained with 4% and 6% salt in the present experiment. These values are presented in Table 4.6. The data obtained from Arthur and Maggie are not presented here, as

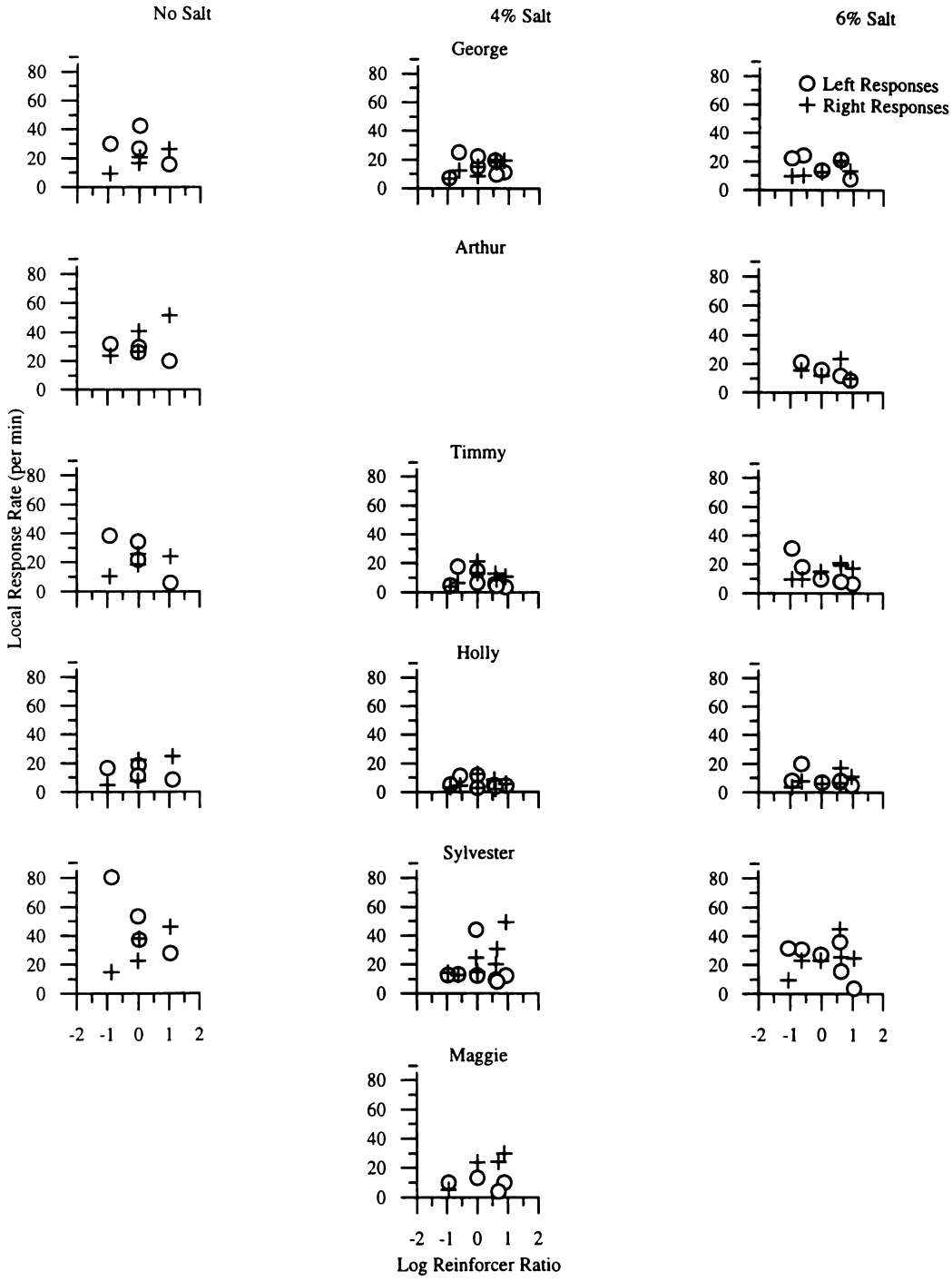


Figure 4.13. The local rate of responding per minute on the left and right levers for the No Salt, 4% Salt and 6% salt conditions plotted in which the VI schedules were varied, plotted against the logarithm of the obtained reinforcer rate ratio for all possums.

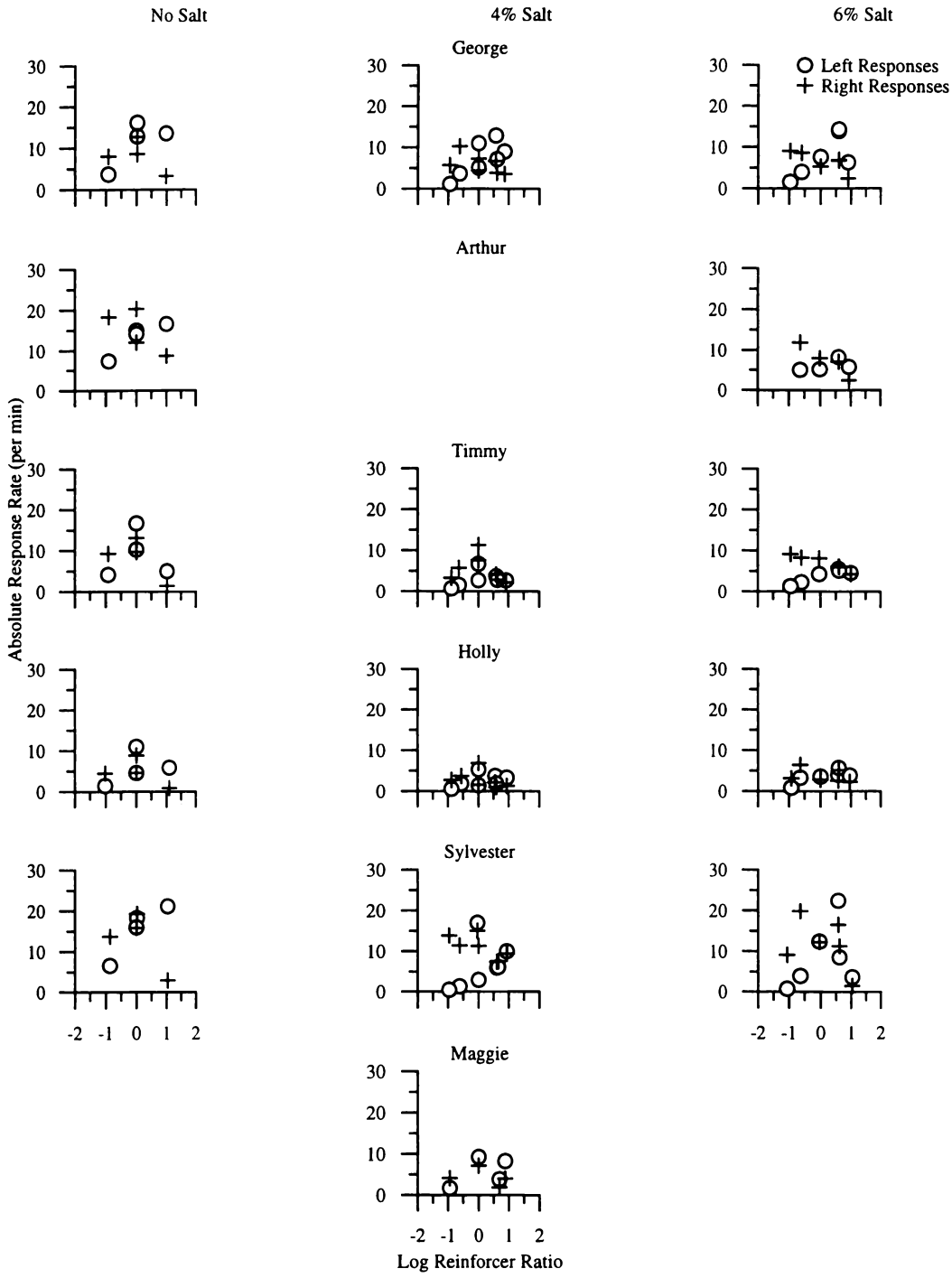


Figure 4.14. The absolute rate of responding per minute on the left and right levers for the No Salt, 4% Salt and 6% salt conditions plotted in which the VI schedules were varied, plotted against the logarithm of the obtained reinforcer rate ratio for all possums.

Table 4.6
The estimates of bias based on the equal schedule conditions (point estimates) and derived from the GML fits from the 4% and 6% Salt conditions. Also presented is the difference between the two estimates, and the change in bias from the 4% to the 6% Salt conditions for each subject, and each measure of bias.

| | Point Estimate (4% Salt) | Matching Line Estimate (4% Salt) | Difference (P.E - M.L.E) 4% Salt | Point Estimate (6% Salt) | Matching Line Estimate (6% Salt) | Difference (P.E - M.L.E) 6% Salt |
|---|---|---|---|---|---|---|
| | | Response | | | Response | |
| George | -0.09 | -0.21 | 0.12 | -0.07 | -0.17 | 0.10 |
| Timmy | -0.07 | -0.36 | 0.29 | -0.15 | -0.42 | 0.27 |
| Holly | -0.09 | -0.17 | 0.08 | -0.12 | -0.17 | 0.05 |
| Sylvester | -0.20 | -0.60 | 0.40 | -0.22 | -0.38 | 0.16 |
| Mean | -0.11 | -0.34 | 0.22 | -0.14 | -0.29 | 0.15 |
| | | Time | | | Time | |
| George | -0.61 | -0.03 | -0.58 | 0.09 | -0.08 | 0.17 |
| Timmy | -0.07 | -0.23 | 0.16 | -0.08 | -0.32 | 0.24 |
| Holly | -0.06 | -0.24 | 0.18 | -0.03 | -0.20 | 0.17 |
| Sylvester | -0.19 | -0.18 | -0.01 | -0.18 | -0.12 | -0.06 |
| Mean | -0.23 | -0.17 | -0.06 | -0.05 | -0.18 | 0.13 |

| | Point Estimate Bias Change (4%-6%) | Matching Line Bias Change (4%-6%) | Point Estimate Bias Change (4%-6%) | Matching Line Bias Change (4% 6%) |
|---|---|---|---|---|
| | Response | | Time | |
| George | -0.02 | -0.04 | -0.70 | 0.05 |
| Timmy | 0.08 | 0.06 | 0.01 | 0.09 |
| Holly | 0.03 | 0.00 | -0.03 | -0.04 |
| Sylvester | 0.02 | -0.22 | -0.01 | -0.06 |
| Mean | 0.03 | -0.05 | -0.18 | 0.01 |

these subjects did not complete all conditions. There are large differences between the values of log *c* obtained from the line estimates and those obtained using the point estimates. The mean values of log *c* obtained from response-allocation data when point estimates were used were –0.11 and –0.14 when 4% and 6% salt were presented, compared to values of –0.34 and –0.14 when the line estimates were used. Similarly, when the time-allocation data were used, the mean point estimates were markedly different from the mean line estimates of bias (-0.23 and -0.05 vs. –0.17 and –0.18, for 4% and 6% respectively).

Even though the actual values of the bias estimates differed markedly, it might be expected that the change in bias from the 4% to the 6% salt conditions would be similar when the two methods were used. The difference between the bias estimates obtained from the 4% and 6% salt conditions is also presented in Table 4.6 for each method. It can be seen from the table that the change in bias was similar for 3 of the 4 subjects for both response and time estimates (in these cases the estimates were within 0.08 of each other). Although not presented here, the same result was observed for post-COD and PRP- and net-time allocation estimates of bias.

## Discussion

The results of the Experiment 3 demonstrated that it was possible to bias the behaviour of possums on concurrent schedules of reinforcement using qualitatively different reinforcers. One aim of the present experiment was to determine whether graded biases could be obtained by systematically changing the quality of the food presented. This change in quality was achieved by increasing the concentration of salt added to the standard reinforcer (barley).

### Point Estimates of Bias

Increasing the concentration of salt had no systematic effects on the bias measures from individual possums. Although with both response- and time-allocation measures the possums' behaviour was, in most cases, biased towards

the Barley in the 0%, 4% and 6% salt conditions, the magnitudes of the biases did not consistently increase or decrease within possums with changes in salt concentration. In addition, when 2% salt was presented, subjects' biases were not consistently either towards or away from this alternative. The mean response bias towards the barley decreased from the 0% to the 2% salt condition, but increased with further increases in salt concentration. This suggests that overall, the possums prefer small amounts of salt (around 2%), with higher salt concentrations being less preferred, as was suggested in the Introduction. However, no such pattern was evident with the mean time-allocation biases.

The mean response- and time-allocation biases obtained in the present experiment were, for all salt concentrations, larger than those found in Experiment 3 with Cocopops, but smaller than those found with Coconut. As in Experiment 3, the bias estimates obtained here fall within the range observed in previous studies (Matthews & Temple, 1979; Miller, 1976).

Response-allocation measures of bias were generally larger in the second half of the session. This was only the case during the 4% and 6% salt conditions for time-allocation measures. This result was also found in Experiment 3 with coconut. As was suggested in that experiment, it is possible that the possums satiated to the salted alternative, and this is reflected in the shift in bias away from the salted alternative from the first half to the second half of the session.

There was very little bias in within-COD responding. Experiments 1, 2 and 3 also demonstrated insensitive responding and little bias during this period. The post-COD bias estimates were generally large, with the mean bias measure increasing with salt concentration. However, again, there were no consistent patterns in the individual subjects' data.

As in Experiment 3, when PRP time was removed from the bias estimates, the remaining (net) time biases were larger than the total-time biases. The PRP-time biases were small in all cases. It might have been expected that PRP biases would be consistently towards the salted alternative, because after the cooking process, the salted barley seemed, to the experimenter, to be noticeably more difficult to chew. However, the direction of the PRP-time bias was not

consistently towards either alternative. This suggests that either the time between receiving a reinforcer and the next response is not spent entirely on 'eating', or that cooking the barley did not affect the difficulty, or time taken, for the possums to eat the food in the same way as was expected when the food was tasted by the experimenter.

Line vs. Point Estimates of Bias

Line estimates of bias were obtained for 4% and 6% salt using both the GML and the C-D model. The estimates of bias obtained from the two models were very similar. For both response and time measures, there were no consistent changes in bias with changes in salt concentration. The mean bias estimates from the two sets of conditions were very similar for response allocation (– 0.19 and – 0.18), with time-allocation measures showing more bias towards the barley during the 6% salt conditions.

The logarithms of the point estimates of bias were compared with the line estimates of bias (with inherent bias removed) for the 4 subjects who completed all conditions. For response allocation, the line-estimate biases were consistently larger than those obtained from the point estimates. When the same comparison was made for time allocation, the point estimates were larger in four cases, and smaller in the remaining four cases. These results suggest little consistency between point and line estimates of bias. It was expected that point estimates of bias would be more variable than line estimates, due to the difference in the number of data points included in the calculation of each measure. It was also expected that the point estimate values would vary to either side of the line estimate values (i.e., sometimes smaller, sometimes larger). This was so for time allocation but not for response allocation.

In this experiment, all of the point-estimate data were collected before the line-estimate data, however, when one of the equal schedules conditions was replicated with 4% salt, after all of the line estimate data had been collected, only 1 subject (Emma) showed a large difference in response allocation across the two conditions, suggesting that these bias estimates are relatively stable. This is

consistent with Matthews' (1983) food preference data from cows, suggesting that bias estimates obtained with qualitatively different reinforcers can be expected to remain stable over a large number of experimental conditions. Therefore, these differences in the bias estimates using point and line estimates are not likely to be due to a change in bias over time.

Despite not finding an even distribution of point estimates around the line estimates for response allocation, it is still possible that the changes in bias from 4% to 6% salt might be consistent across the two measures. For both response- and time-allocation, the change in bias with the two measures was similar for 3 of the 4 subjects, giving some support to this idea.

In order to get a clearer picture of why the two measures may have differed, the difference between the predicted and obtained logarithms of the response ratios (i.e., the residuals) from the GML analysis were plotted against the logarithms of the obtained reinforcer ratios in the two left-most panels of Figure 4.15 for the 4% and 6% salt conditions. The solid line on each of these graphs indicates the point where the predicted and obtained ratios were equal. In most cases, the data appear to form a U-shaped function when plotted in this way, indicating systematic deviations from the straight line predicted by the GML. This U-shaped function helps explain the difference in bias estimates using point and line estimates. The function is relatively symmetrical, with the equal schedule data at the base of the U, indicating smaller response ratios when compared to the unequal-schedules data, therefore resulting in different estimates of bias. It is not clear why this U-shaped function might be present.

The differences between the predicted and obtained logarithms of the response ratios from Experiment 2 were also plotted against the obtained reinforcer ratios (Figure 4.16). With these data, although the U-shaped function is present in a few cases, it is not as common a finding as in the present experiment. This function suggests there is an interaction between the reinforcer-rate ratio and the different reinforcers used, with possums showing larger biases towards barley when the salted alternative was associated with the rich alternative. This will be discussed further later.

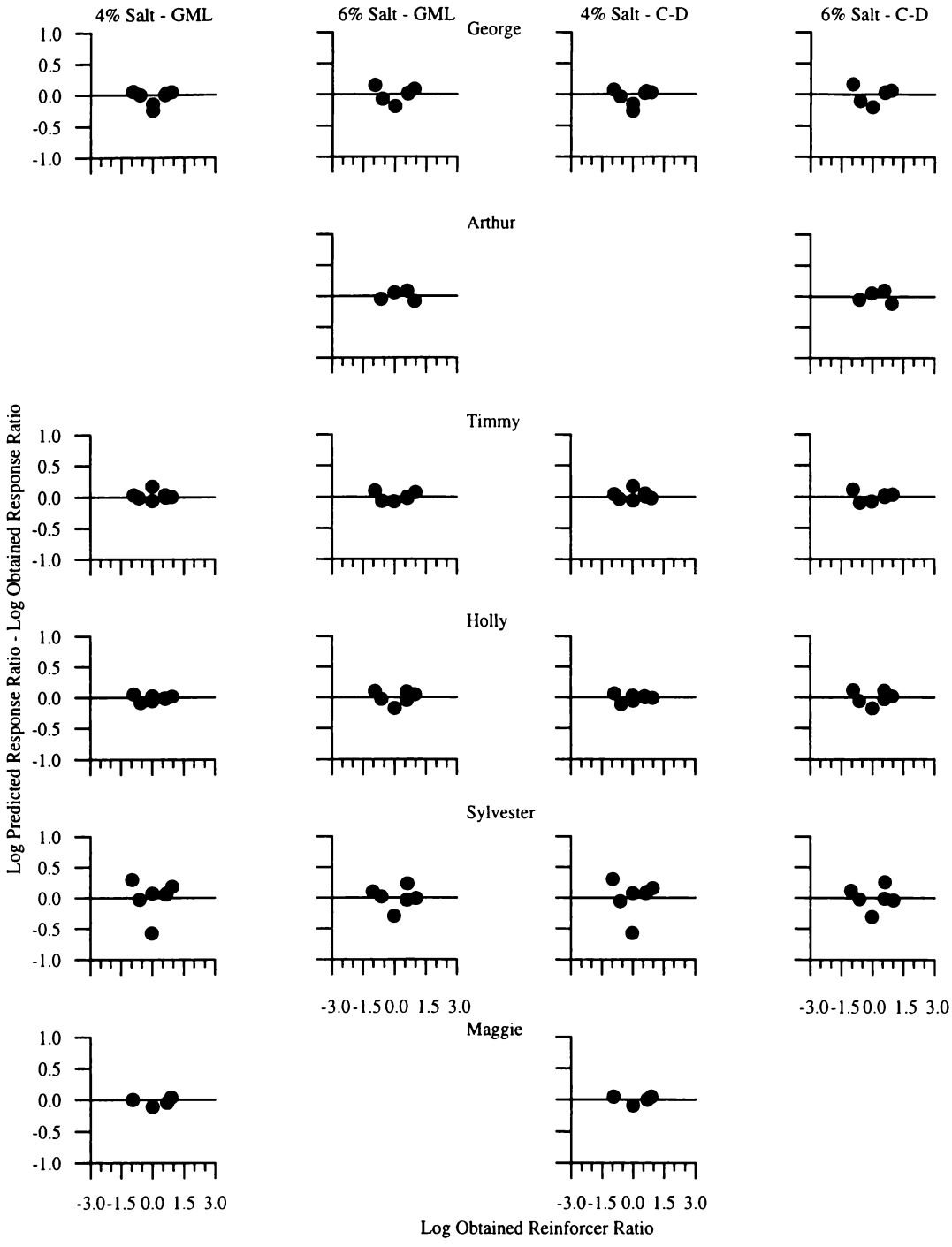


Figure 4.15. The difference between the predicted and obtained logarithms of the response ratios plotted against the logarithms of the obtained reinforcer ratios for the data from Experiment 4. The two leftmost panels show the analysis using the GML and the two rightmost panels show the analysis using the C-D model, from the 4% and 6% salt conditions, respectively.

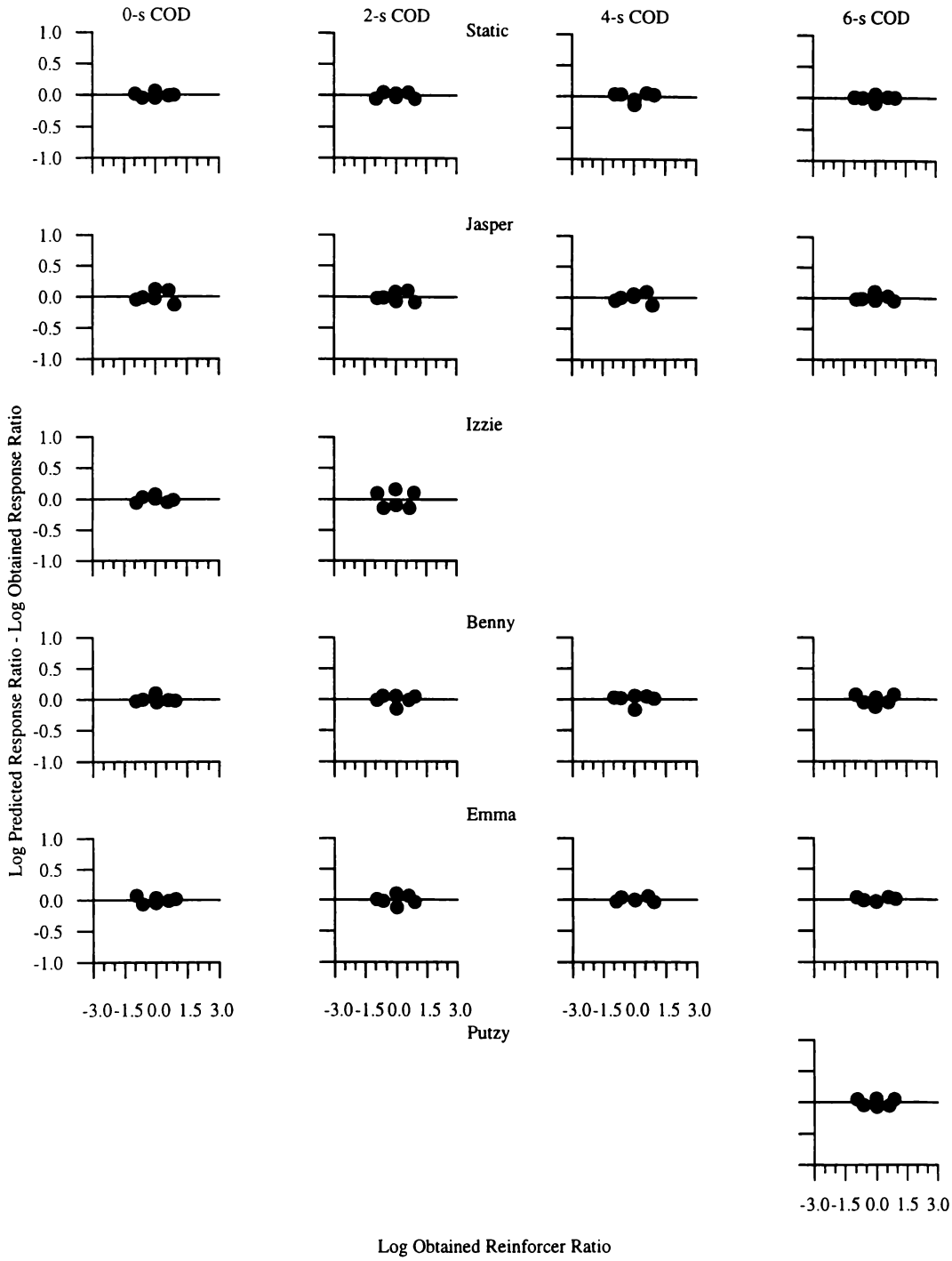


Figure 4.16. The difference between the predicted and obtained logarithms of the response ratios plotted against the logarithms of the obtained reinforcer ratios for the data from Experiment 2. Here, the data were analysed using the GML.

The within-COD response and PRP-time biases were generally small, with most of the food bias being present in the post-COD response and net-time allocation data. Again, there were no consistent changes in bias with changes in salt concentration, and there were large differences between the point and line estimates of bias. As was the case with the point estimates, the PRP biases were not consistently towards the salted alternative, as might have been expected if the PRP-time were actually entirely devoted to eating.

With both point and line estimates, the rank order of biases across concentrations was not consistent across subjects. There is no obvious reason to expect similar results across possums. When Hudson et al. (1999) studied the food preferences of possums, they found that each of the possums preferred a different food, with foods that were highly preferred by some subjects not being eaten at all by other subjects. Other studies that have used concurrent schedules to measure food biases have also found differences across subjects (e.g., Matthews & Temple, 1979; Miller, 1976). Given these results, it would be unreasonable to expect the order of preferences to be the same for all possums.

Sensitivity/Discriminability

One of the aims of the present experiment was to examine, and compare, how the GML and the C-D model cope with experimentally introduced biasers. Neither the sensitivity ($a$) nor the discriminability ($d_r$) measure changed consistently with changes in salt concentration. It might have been expected that changing from one magazine which provided reinforcers for responses to both alternatives to two magazines, each associated with a different response alternative, and providing different feeds, would have improved the discriminability of the response-reinforcer contingencies. However, the measures obtained from the present experiment were similar to those obtained in Experiment 1. There were no consistent increases in $d_r$ values from Experiment 1 to the present Experiment.

Given the large biases away from 4% and 6% salt, it is unlikely that the subjects could not discriminate between the feeds, or the responses that were

producing them. Therefore, the lack of change in $d_r$ values from Experiment 1 to the present experiment suggest that this parameter may not actually be measuring the response-reinforcer contingencies. Previous studies have shown that when the stimuli associated with the schedules are made more different the calculated values of $d_r$ required to fit the data increase. Presumably this reflects an increase in discriminability. Davison and his colleagues have not published any studies where other methods of improving the response-reinforcer discriminability have been attempted. It may be that the parameter $d_r$ actually measures the stimulus-response relationship rather than the response-reinforcer relationship.

It is possible that the problem lies in the way the bias due to the different foods was included in the model. Davison and Nevin (1999) noted that while reinforcer quality could be incorporated into the model, such experimental conditions would result in both the reinforcer value and the response-reinforcer relations being altered, and suggested that the model should allow for this. However, they made no suggestions as to how such variables could be included in the model.

As previously mentioned, the data here showed systematic deviations from the straight line predicted by the GML (Figure 4.15). Figure 4.15 also shows the differences between the logarithms of the predicted and obtained response ratios when the C-D model was used. The pattern of deviations was very similar to that observed with the GML (a U-shaped function), suggesting, as mentioned above, an interaction between the reinforcer-rate ratio and the different reinforcers used. Therefore, it may be that this function is the result of an improvement in discriminability due to the different foods, but that this aspect of discriminability affects behaviour in a different manner to factors such as stimulus disparity (which has been shown to affect the measure of discriminability in the C-D model). The fact that this U-shaped function was not observed in Experiment 2, where the foods were the same and the COD length was varied, adds support to the idea that this function is somehow related to the different foods presented.

Consistent with the present findings, Sumpter (1996) found that when attempting to bias behaviour under concurrent VI (key peck) VI (door push)

schedules of reinforcement, with increasing door weight, the effects of the door weight were not constant with changes in the schedules associated with each alternative (as was found in here). Arranging different response requirements would be expected to increase the discriminability of the response-reinforcer contingencies, and therefore Sumpter's (1996) results support the idea that the U-shaped function found in here was the result of a change in discriminability. However, Sumpter (1996) also found evidence of increased sensitivity estimates with the different force requirements associated with the door. Having different response requirements, such as a key and a door could conceivably have effects on behaviour analogous to increasing the stimulus disparity (with increases in door weight resulting in further increases in disparity), which increases sensitivity and therefore the discriminability measure in the C-D model. In finding both an increase in sensitivity and an interaction between the reinforcer-rate ratio and bias, Sumpter's results support the previous suggestion that $d_r$ is actually measuring some aspect of the stimulus-response relationship, whereas changes in discriminability due to biasers affect behaviour in a different manner. Further research into the effects of different types of biasers on concurrent-schedule behaviour is needed to clarify this issue.

When the C-D model was used to analyse the response, time and post-COD response data, there were four cases where negative (and therefore, un-interpretable) values of $d_r$ were found. In those cases, the values of $p_r$ were close to 1.0 (ranging from 1.02 to 1.04), and it might be argued by some that discriminability was actually perfect (e.g., Davison & Jenkins, 1985). Alternatively, such occurrences may indicate a failure of the model. Two of the instances where $p_r$ was greater than 1.0 occurred with the post-COD data. Davison and McCarthy's punishment version of the C-D model was proposed to deal with such data. However, given the results of Experiment 2, where the model failed to account for this 'overmatching' this model was not fitted to these data.

Changeover Rates

The rate of changing over in the present experiment did not conform to

an inverted U-shaped function when plotted against the logarithms of the response, time or reinforcer-rate ratios. This result is inconsistent with results from Experiments 1 and 2 (and Experiment 3 for the logarithms of the time-allocation ratio only), as well as previous studies (e.g., Baum, 1974; Catania, 1963; Herrnstein, 1961; Sumpter et al., 1995). There is no obvious reason for this finding. It might be, in part, due to the use of qualitatively different reinforcers. The inverted U-shaped function was not as defined in Experiment 3, where qualitatively different reinforcers were also used, and was absent when the CO rate was plotted against the logarithms of the response-allocation ratios. In addition, there were a greater number of conditions in the present experiment. Had a similar number of conditions been conducted in Experiment 3, the U-shaped relation may have been obscured.

Response Rates

The absolute rate of responding on a lever generally increased as the rate of reinforcement associated with that lever increased. When equal schedules were used, the absolute rates of responding were generally faster on the preferred alternative. The local rate of responding generally decreased as the rate of reinforcement associated with that lever increased. When equal schedules were used, there was no relation between local response rate and bias. These results are consistent with those from Experiments 1, 2 and 3, as well as with previous studies (Baum, 1979; Davison & Ferguson, 1978; Herrnstein, 1961). The actual rates of responding were generally slower than was observed in Experiment 1. This may have been due to the presence of a 'non-preferred' food. Similar rates of responding were observed in Experiment 3, providing support for this idea.

The present experiment showed that the GML and the C-D model describe behaviour with qualitatively different reinforcers equally well, giving similar %VAC measures. It was also seen that the bias estimates were not constant across reinforcer-rate ratios. This resulted in systematic deviations from the lines predicted by both models, suggesting that neither model is better suited to the analysis of such data. While it may be possible to modify the C-D model in such

a way that the interaction between bias and discriminability is accounted for (as suggested by Davison & Nevin, 1999), it is not clear how this could be done.

# GENERAL DISCUSSION

## General Possum Behaviour

These experiments constitute a comprehensive study of the behaviour of possums under concurrent VI VI schedules of reinforcement. It has been shown that the behaviour of possums is similar to that of other species in the following ways:

- The sensitivity of the possums response-allocation to reinforcement-rate differences was within the range found with other species.
- The time-allocation ratios approximately matched the reinforcer-rate ratio.
- Time allocation was more sensitive to reinforcer-rate changes than was response allocation.
- Responding within the COD was insensitive to changes in the reinforcer-rate ratio.
- Responding during the COD was faster than at any other time.
- The rates of changing over decreased as the reinforcer rates on the two schedules became more different (when the reinforcer was the same on both alternatives) and as the COD length increased.
- The local response rates were faster on the lean alternative and, as expected, the absolute response rates were faster on the rich alternative.
- With concurrent EXT VI schedules, a small amount of responding was observed on the extinction alternative for most possums.

Despite behaving in a way that was very similar to other species, there were some inconsistencies between the behaviour of the two groups of possums studied here. While the response-based sensitivity estimates from Experiments 1, 2 and 4 were similar (with a greater amount of undermatching than is normally found with rats, pigeons and hens (Davison & Hunter, 1976; Hollard & Davison,

1978; Logue & de Villiers, 1978; Norman & McSweeney, 1978; Temple et al., 1995)), in Experiment 2, the sensitivity of the post-COD response allocation was similar to that which has been found with other species (McAdie et al., 1996; Shahan & Lattal, 1998; Temple et al., 1995), and was consistently higher than in Experiments 1 and 4 (see Table 5.1). Inspection of the data suggests that this may be due to different patterns of responding within the COD between Experiment 2 and Experiments 1 and 4.

The within-COD sensitivity measures from Experiments 1,2 (2-s COD only), and 4 are presented in Table 5.1. There are no consistent differences between the within-COD sensitivity estimates from those experiments. It may be that the differences in post-COD sensitivity estimates are a function of the amount of time spent, and therefore, the number of responses made, during the COD. The rate of changing over in Experiment 2 was found to be lower than that in Experiment 1. In addition, the rate of responding during the COD was faster than at any other time during the session, and the number of responses made to each alternative within the COD are approximately equal (i.e., local response rates are approximately equal). On the other hand, the local rates of responding after the COD were fount to change with changes in the reinforcer rate ratio, and were approximately equal only when the schedules associated with the two alternatives were equal. If one group of possums was consistently changing over more often than the other, this would result in a smaller amount of post-COD responding, and therefore, a smaller amount of differential responding on the two alternatives, which could influence the post-COD sensitivity estimates. It was also noted that the response rates differed across experiments, which could add to this effect.

In order to examine the possibilities mentioned above, Figure 5.1 shows the mean changeover rates plotted against the logarithms of the time-allocation ratios, as well as the mean local and absolute response rates plotted against the logarithms of the reinforcer ratios for Experiments 1, 2 (with a 2-s COD), and 4 (for both 4% and 6% salt). These graphs show that the rates of changing over were similar during Experiments 2 and 4 (and lower than during Experiment 1), while the rates of responding were similar in Experiments 1 and 2, and higher than

Table 5.1

The mean and range of response, time, post COD, and within COD *a* values with each COD, from Experiments 1, 2 and 4.

| | 0-s COD | | 2-s COD | | 4-s COD | | 6-s COD | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Range | Mean | Range | Mean | Range | Mean | Range |
| Response | 0.5 | 0.45 - 0.56 | 0.54 | 0.43 - 0.71 | 0.6 | 0.31 - 0.84 | 0.56 | 0.28 - 0.72 |
| Time | 0.79 | 0.69 - 0.84 | 0.98 | 0.92 - 1.14 | 0.97 | 0.86 - 1.09 | 0.91 | 0.75 - 1.13 |
| Post COD Responses | 0.68 | 0.59 - 0.76 | 1.02 | 0.88 - 1.14 | 1.18 | 0.92 - 1.26 | 1.11 | 0.87 - 1.44 |
| Within COD Responses | - | - | 0.00 | -0.18 - 0.07 | -0.04 | -0.34 - 0.15 | -0.07 | -0.44 - 0.21 |

| | Experiment 1 - 2-s COD | |
|---|---|---|
| | Mean | Range |
| Response | 0.51 | 0.36 - 0.63 |
| Time | 0.96 | 0.64 - 1.13 |
| Post COD Responses | 0.77 | 0.49 - 1.01 |
| Within COD Responses | 0.04 | -0.11 - 0.15 |

| | Experiment 4 - 4% Salt, 2-s COD | |
|---|---|---|
| | Mean | Range |
| Response | 0.55 | 0.40 - 0.74 |
| Time | 0.88 | 0.77 - 1.07 |
| Post COD Responses | 0.87 | 0.74 - 1.08 |
| Within COD Responses | -0.02 | -0.06 - 0.05 |

| | Experiment 4 - 6% Salt, 2-s COD | |
|---|---|---|
| | Mean | Range |
| Response | 0.51 | 0.38 - 0.64 |
| Time | 0.88 | 0.65 - 1.13 |
| Post COD Responses | 0.81 | 0.61 - 1.05 |
| Within COD Responses | 0.03 | -0.02 - 0.09 |

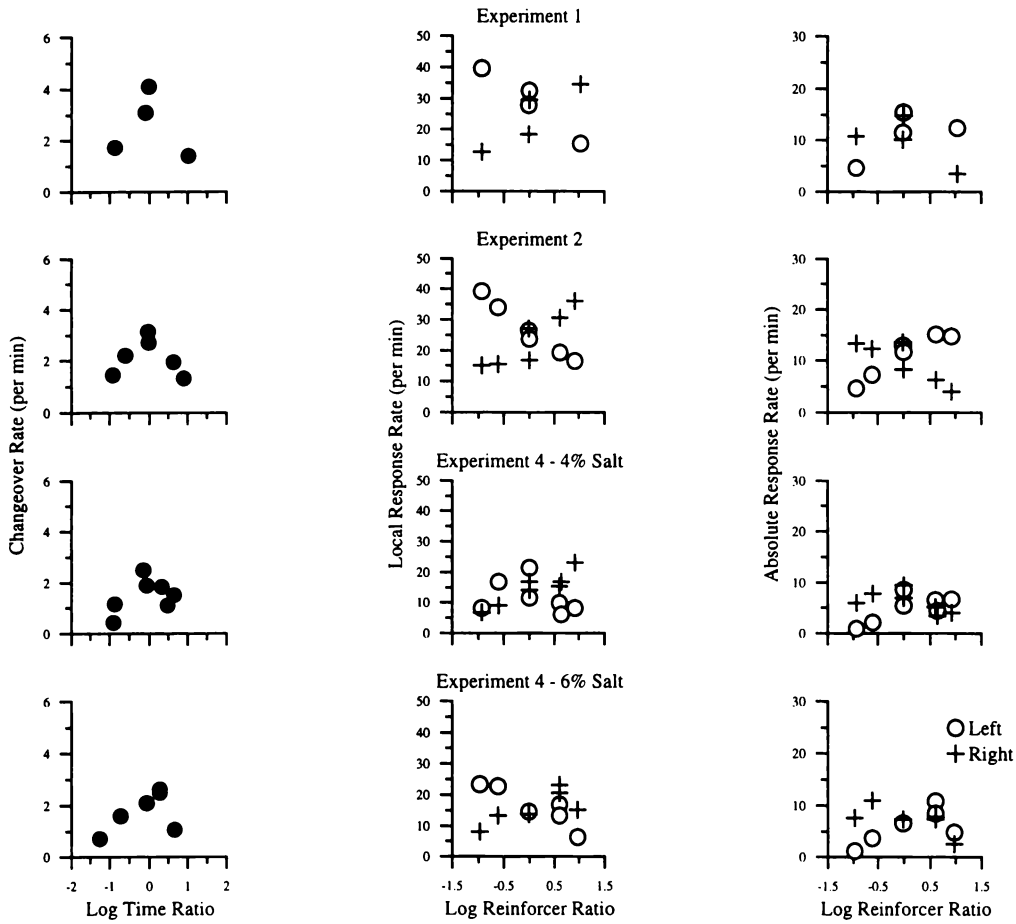


Figure 5.1. The mean changeover rates plotted against the logarithms of the time allocation ratios (left panel), and the mean local response rates (centre panel) and mean absolute response rates (right panel) plotted against the logarithms of the reinforcer ratios from Experiments 1, 2 (with a 2-s COD), and 4 (for 4% and 6% salt conditions where the schedules were varied).

in Experiment 4. It appears that the decrease in both response rates and changeover rates from Experiment 1 to Experiment 4 was approximately proportional. Therefore, although both of these aspects of behaviour had changed, there was no corresponding change in sensitivity. On the other hand, in Experiment 2, while the rates of changing over were lower than in Experiment 1, the rates of responding were similar. This means that in Experiment 2, a greater portion of the responses occurred outside the COD. As mentioned previously, responding within the COD was insensitive to changes in the reinforcer-rate ratio. Therefore, when more responses are made outside the COD, where the ratio of responses changes with the ratio of reinforcement, behaviour will become more extreme, resulting in the greater sensitivity found for post-COD responding in Experiment 2.

While this explains how the differences in post-COD responding came about, it does not address why they were present in the first place. The most likely explanation is the subjects' previous experience. The subjects used in Experiments 1 and 4 had only ever experienced a 2-s COD, whereas the subjects in Experiment 2 were first exposed to six conditions with a 0-s COD. It is possible that the change from a 0-s COD to a 2-s COD had a greater effect on the rate of changing over than simply introducing a 2-s COD. The differences in the rates of changing over between Experiments 1 and 4 are likely to be due to the different foods presented. When preference for an alternative is manipulated by changing the reinforcer ratio, the rate of changing over also changes (becoming slower as the alternatives become more different). Therefore, it is not unreasonable to expect the same effect when preference is manipulated in other ways (i.e., lower rates of changing over as preference moves further away from indifference, regardless of the cause of the preference change). This effect was also seen when McAdie et al. (1996) studied the effects of an overlaid noise on concurrent-schedule behaviour with hens.

## Food Preference

In Experiments 3 and 4, an in-depth analysis of behaviour with

qualitatively different reinforcers was conducted. Generally, the results of these experiments were consistent with previous studies (e.g., Matthews & Temple, 1979; Miller, 1976), in that the degree of the biases were similar, and there were inconsistent differences between the response- and time-bias estimates across subjects, with these estimates sometimes being in opposite directions. In the present experiments, there was no attempt made to measure consumption of the different foods, so it is not known how well the estimates of bias relate to how much of each of the foods was eaten. Recording such data would provide an indication of how preference measured in this way relates to consumption, which would be helpful in the search for a bait for use with possums in the wild.

These experiments also demonstrated that biases due to qualitatively different foods are not present in behaviour during the COD. The effects of food biasers on within-COD behaviour has not previously been studied, but a similar result was observed by McAdie et al. (1996) using noise biasers. These results suggest that no matter how preference is manipulated, whether it be by changing the rates of reinforcement, or by introducing biasers such as different foods, different flavours, or presenting an aversive noise while responding on one of the alternatives, very little change will be observed in responding within the COD. These findings further support Baum's (1982) and Temple et al's. (1995), suggestion that responding during the COD is discriminated by the subject (i.e., this behaviour does not change with changes in preference measures), and therefore can be removed from the data before analysis.

## The Contingency-Discriminability Model

It appears from the results of Experiment 2, that increasing the length of the COD does not improve the response-reinforcer discriminability for possums. When the COD was increased from 0 s to 6 s in 2-s intervals, no consistent changes in discriminability were observed. To date, the only cases where discriminability has been shown to improve have involved changing the disparity of the stimuli (Alsop & Davison, 1991; Davison & Jenkins, 1985). Davison and Nevin (1999) suggested that manipulating variables such as the quality, magnitude

and duration of reinforcement should also affect discriminability. Experiment 4 suggested that this is not the case for food quality, at least with the current form of the model. However, while the estimates of discriminability did not change, an interaction was observed between bias and reinforcer-rate ratio. As mentioned previously, Davison and Nevin suggested that the model would need to be modified in such a way that would enable both discriminability and bias to vary with introduced biasers, which could account for the interaction observed in Experiment 4.

In general, the C-D model described the data from these possums equally as well as the GML (giving similar %VAC measures). There were no obvious s-shaped functions in the data from these experiments when the logarithms of the response ratios were plotted against the logarithms of the reinforcer ratios. It should be noted again that Davison and Jones (1995) stated that these models should differ only outside the range of reinforcer-rate ratios used in these experiments, and so this s-shaped function should presumably be noticeable only in such cases. However, Baum et al. (1999) suggested that the s-shaped function obtained by Davison and Jones (1995) when the logarithms of the response ratios were plotted against the logarithms of the reinforcer ratios may have been a direct result of the procedure used. Their experiment used dependent schedules, a 3-s COD, and a changeover key procedure with more confusable stimuli (two different levels of brightness) than most concurrent schedule experiments. Baum et al. (1999) studied choice behaviour over a similar range of reinforcer-rate ratios using independent schedules of reinforcement on a standard two-key concurrent schedule procedure without a changeover delay. Under these conditions, Baum et al. failed to obtain the s-shaped function obtained by Davison and Jones (1995), and in fact found that the GML provided a better description of the subjects' behaviour than did the C-D model when the %VAC measures were compared.

Baum et al. (1999) suggested that the small amount of undermatching generally found in studies using concurrent VI VI schedules of reinforcement is actually a direct result of the way the data are analysed. They suggested that instead of looking at behaviour in terms of the position or colour of the associated

response alternatives, it may be more appropriate to look at behaviour in terms of the preferred and non-preferred alternatives. When their data were treated in this way, the undermatching that was observed with the traditional generalised matching law appeared as a bias towards the non-preferred alternative (with a slope of approximately 1.0). As a result of this finding they proposed that there are two distinct reasons why undermatching is often observed. The first, which they suggested was the case in their experiment, apparently results from fitting an inappropriate equation (i.e., the GML), and therefore, is not really undermatching (as this can be eliminated by plotting the preferred vs. the non-preferred alternatives). The second is the result of poor discriminability, in which case the C-D model (with preferred and non-preferred alternatives substituted for left and right alternatives) should be used instead.

Baum et al. (1999) proposed an alternative equation to the GML:

$$\log (N/B_P) = \log (r_N/r_P) - \log D - \log c \qquad (5.1)$$

where $N$ is the number of visits to the non-preferred alternative (or half the number of changeovers), $B_P$ is the number of responses or amount of time spent on the preferred alternative, $r_N$ and $r_P$ are the numbers of reinforcers obtained on the non-preferred and preferred alternatives respectively, $D$ is the number of responses or amount of time spent per visit to the non-preferred alternative, $B_N/N$ (i.e., $D = B_N/N$), and $c$ is a measure of bias.

Equation 5.1 states that the probability of visiting the lean alternative depends directly on the ratio of reinforcement. This model is based on the assumption that subjects will make most of their responses (or spend most of their time) on the preferred alternative, with only brief visits to the non-preferred alternative. Baum et al. recommend the use of this equation only if the subjects' behaviour matches the reinforcer-rate ratio (otherwise the C-D model is more appropriate). However, if this is the case, the above equation is of little use over and above the matching law, as it is simply a slightly re-arranged version of the matching law. Substituting $B_N/N$ for $D$ gives:

$$\log (N/B_P) = \log (r_N/r_P) - \log (B_N/N) - \log c \qquad (5.2)$$

adding log ($B_N/N$) gives:

$$\log (N/B_P, B_N/N) = \log (r_N/r_P) - \log c \quad (5.3)$$

or

$$\log (B_N/B_P) = \log (r_N/r_P) - \log c \quad (5.4)$$

which is the GML expressed as the ratios of the non-preferred to the preferred alternatives, without a sensitivity parameter (which is not necessary because matching must be obtained before this equation can be used), and with bias subtracted rather than added.

It appears that the presence of position biases prevents the use of the above equation. Baum et al. (1999) noted that such an analysis was only possible for their data because there were no apparent position biases for any of their subjects. Just as biases towards the preferred or non-preferred alternative result in deviations from matching with the traditional GML, biases towards the left and right alternatives will result in deviations from matching when using Baum et al.'s modified matching law. Using Baum et al.'s equation, then, it would be difficult (although not impossible) to study the effects of experimentally manipulated biasers other than the reinforcer rate.

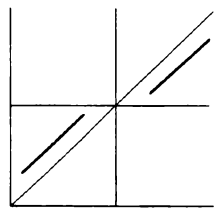

Figure 5.2. An approximation of the figures presented by Baum et al. (1999) when separate regression lines were fitted to the concurrent schedule data where the schedules associated with the left key were rich, and where the schedules associated with the right key were rich.

Baum et al. (1999) initially proposed plotting concurrent VI VI schedule data in terms of preferred versus non-preferred alternatives based on data from pigeons which showed that when two separate regression lines were fitted, one to the

data where the preferred alternative was on the left, and one to the data where the preferred alternative was on the right, each line had a slope of approximately 1.0, with biases in the direction of the non-preferred alternative. This is illustrated above in Figure 5.2.

This analysis was carried out with the data from Experiment 2. Figure 5.3 shows the data from each of the COD lengths. For each subject, the logarithms of the response ratios are plotted against the logarithms of the reinforcer ratios. The data from the conditions in which the schedules were equal are not included here. The dotted line on each graph represents strict matching. The solid and dashed lines on each graph are the lines fitted through the two data points for the conditions where the preferred alternative was on the right (left side of the graphs) and left (right side of the graphs) respectively. When Baum et al. did this analysis with their pigeon data, the lines of best fit were parallel to the strict matching line in all cases. In five cases in Experiment 2, one of the lines was approximately parallel to strict matching, however, this was not the case for both sets of data for any of the subjects with any of the COD lengths in Experiment 2.

Table 5.2 gives the slopes and intercepts of each of the lines presented in Figure 5.3, as well as the slopes and intercepts of the overall regression lines (including the data from the equal-schedule conditions). Baum et al. suggested that $a$ values of around 0.8 were the result of a bias towards the non-preferred alternative. Therefore, this method of analysing concurrent-schedule data may not be appropriate here, since $a$ values of around 0.8 were generally not observed.

Temple et al. (1995) studied the behaviour of hens over a wide range of COD values, and did find sensitivity estimates of approximately 0.8, therefore, the above analysis was also carried out on their data. Figure 5.4 shows the data from three of the COD lengths used by Temple et al. For each subject, the logarithms of the response ratios are plotted against the logarithms of the reinforcer ratios when there was no COD (left panel), a 2-s COD (centre panel), and a 4-s COD (right panel). Again, the data from the conditions in which the schedules were equal are not included here. The dotted line on each graph represents strict

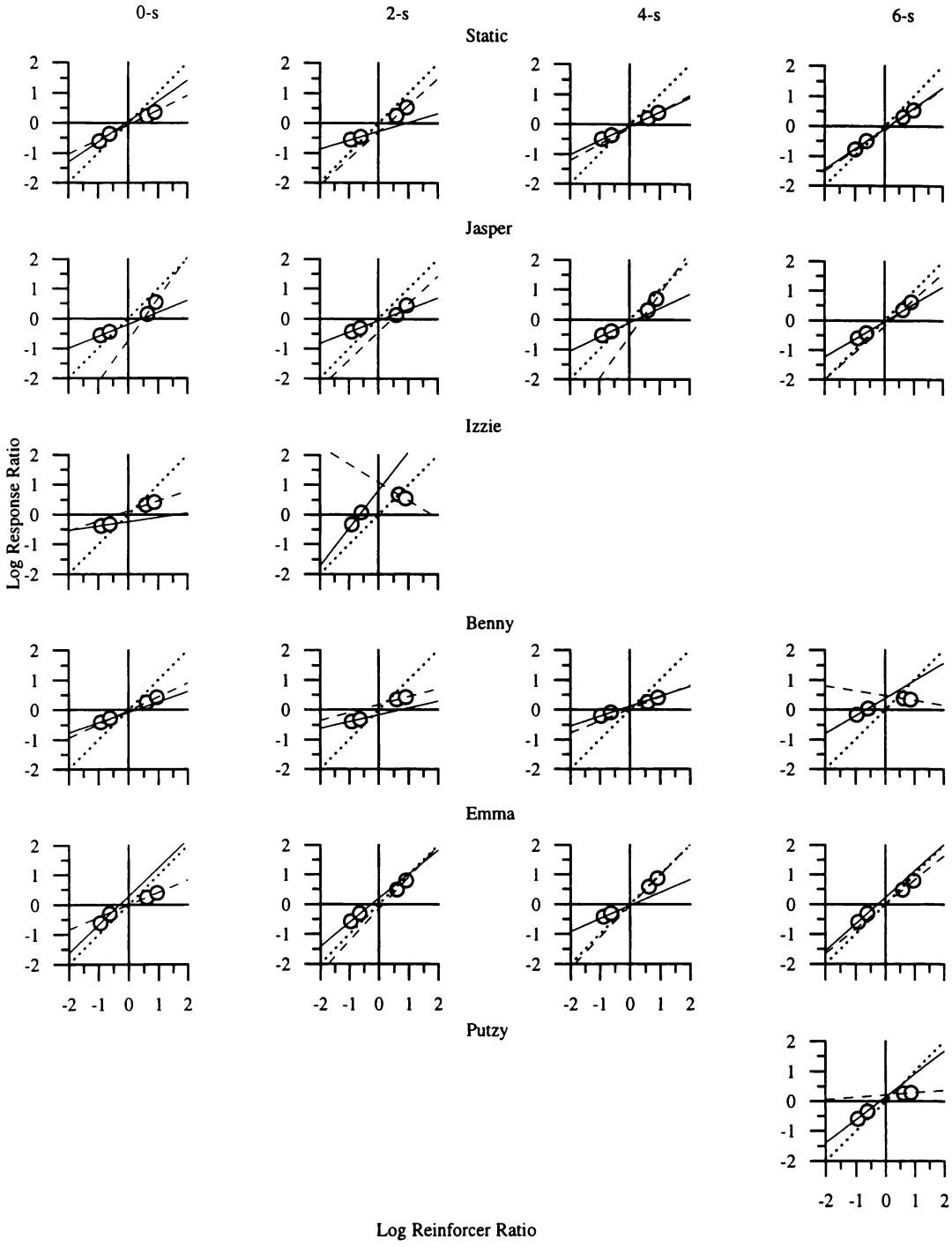


Figure 5.3. The logarithms of the response ratios plotted against the logarithms of the reinforcer ratios for the data from Experiment 2. The dotted line represents perfect matching, and the solid and dashed lines are the lines of best fit for the conditions where the preferred alternative was on the right (left side of the graphs) and left (right side of the graphs) respectively.

Table 5.2

Slopes ($a$) and y-intercepts (log $c$) of the lines of best fit from Figure 5.4. Lines were fitted to the data from conditions in Experiment 2 where the preferred alternative was associated with the left and right levers separately. Also presented are the slopes and intercepts from the original GML analysis.

| | Left | | Right | | Overall | |
|---|---|---|---|---|---|---|
| | Slope | Intercept | Slope | Intercept | Slope | Intercept |
| Possum | ($a$) | (log $c$) | ($a$) | (log $c$) | ($a$) | (log $c$) |
| | | | 0-s COD | | | |
| Static | 0.49 | -0.07 | 0.68 | 0.05 | 0.51 | -0.09 |
| Jasper | 1.39 | -0.73 | 0.40 | -0.20 | 0.56 | -0.10 |
| Izzie | 0.34 | 0.12 | 0.15 | -0.24 | 0.48 | -0.01 |
| Benny | 0.46 | -0.02 | 0.35 | -0.08 | 0.45 | -0.02 |
| Emma | 0.42 | -0.01 | 0.96 | 0.29 | 0.51 | -0.07 |
| MEAN | 0.62 | -0.14 | 0.51 | -0.04 | 0.50 | -0.06 |
| | | | 2-s COD | | | |
| Static | 0.90 | -0.30 | 0.30 | -0.27 | 0.58 | -0.05 |
| Jasper | 0.94 | -0.45 | 0.38 | -0.07 | 0.43 | -0.05 |
| Izzie | -0.61 | 1.10 | 1.28 | 0.83 | 0.50 | 0.22 |
| Benny | 0.27 | 0.18 | 0.23 | -0.17 | 0.47 | 0.05 |
| Emma | 1.07 | -0.16 | 0.81 | 0.21 | 0.71 | 0.12 |
| MEAN | 0.52 | 0.07 | 0.60 | 0.10 | 0.54 | 0.06 |
| | | | 4-s COD | | | |
| Static | 0.55 | -0.12 | 0.48 | -0.06 | 0.48 | -0.02 |
| Jasper | 1.41 | -0.55 | 0.48 | -0.10 | 0.65 | 0.00 |
| Izzie | - | - | - | - | 0.84 | 0.53 |
| Benny | 0.40 | 0.03 | 0.33 | 0.12 | 0.31 | 0.12 |
| Emma | 1.04 | -0.06 | 0.44 | -0.04 | 0.73 | 0.18 |
| MEAN | 0.85 | -0.18 | 0.43 | -0.02 | 0.60 | 0.16 |
| | | | 6-s COD | | | |
| Static | 0.69 | -0.13 | 0.68 | -0.08 | 0.66 | -0.10 |
| Jasper | 0.90 | -0.20 | 0.59 | -0.05 | 0.66 | -0.02 |
| Putzy | 0.08 | 0.21 | 0.77 | 0.14 | 0.48 | -0.09 |
| Benny | -0.16 | 0.48 | 0.59 | 0.39 | 0.28 | 0.17 |
| Emma | 0.82 | 0.00 | 0.89 | 0.23 | 0.72 | 0.11 |
| MEAN | 0.47 | 0.07 | 0.71 | 0.12 | 0.56 | 0.01 |

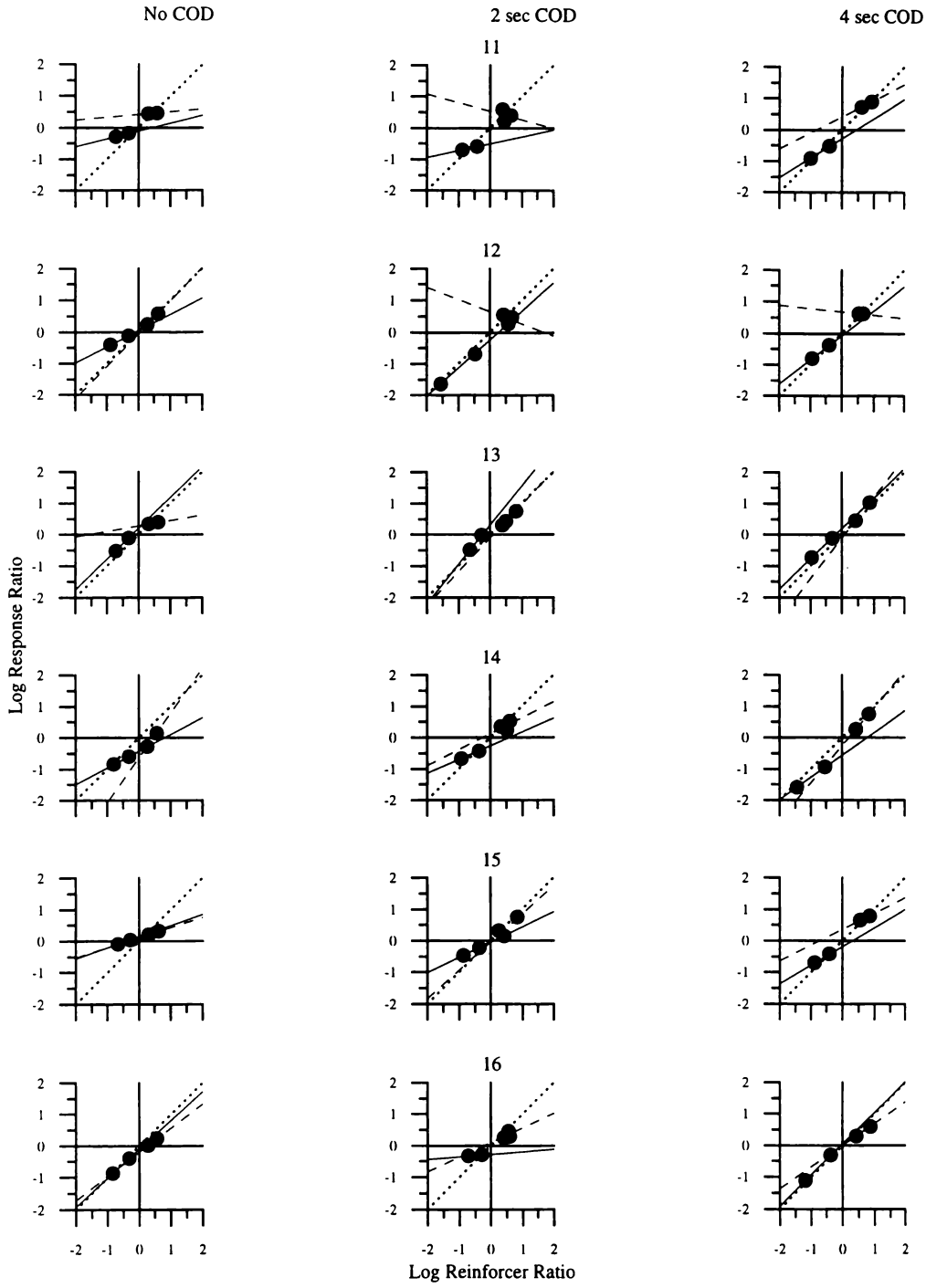


Figure 5.4. The logarithms of the response ratios plotted against the logarithms of the reinforcer ratios for the data from the no COD (left panel), 2 s COD (centre panel), and 4 s COD (right panel) conditions of Temple et al.'s (1995) experiment. The dotted line represents perfect matching, and the solid and dashed lines are the lines of best fit for the conditions where the preferred alternative was on the right (left side of the graphs) and left (right side of the graphs) respectively.

matching. The solid and dashed lines on each graph are the lines fitted to the data for the conditions where the preferred alternative was on the right (left side of the graphs) and left (right side of the graphs), respectively. Again, unlike Baum et al.'s data, the lines were not parallel to the strict matching line for any of the subjects with any of the COD lengths in Temple et al.'s experiment (although the data from the 7.5-s and 15-s COD conditions are not presented here, this was also true of those sets of conditions).

Table 5.3 gives the slopes and intercepts of each of the lines presented in Figure 5.4, as well as the slopes and intercepts of the overall regression lines (including the data from the equal-schedule conditions). The data from Temple et al.'s experiment using hens clearly show that the finding of *a* values of around 0.8 was not the result of a bias towards the non-preferred alternative. In several cases, *a* values of around 0.8 were obtained with the overall response-allocation data, however, fitting two separate regression lines did not indicate matching in terms of the preferred and non-preferred alternatives in any of these cases.

In most cases in Figures 5.3 and 5.4, the lines were fitted to only two data points. It is possible that a larger number of conditions, over a wider range of reinforcer-rate ratios would have shown a closer approximation to matching with hens. However, in the cases where three data points were used, the slopes of the lines were not closer to 1.0 (in fact, in two cases, the slopes were actually negative).

The GML vs. the C-D model

One of the aims of this thesis was to examine the suitability of the GML and the C-D model for the analysis of concurrent VI VI schedule behaviour. Five attributes were identified in the General Introduction which are desirable in such a model: 1. It must fit the data well; 2. The parameters must be logical and defensible; 3. The inclusion of parameters should depend on theory, not data; 4. The parameter values should be reasonable in terms of the assumptions; 5. The model should be predictive of changes in the data with changes in the

Table 5.3
Slopes ($a$) and intercepts (log $c$) of the lines of best fit from Figure 5.5. Lines were fitted to the data from conditions where the preferred alternative was associated with the left and right key seperately. Also presented are the slopes and intercepts from the original analysis by Temple et al. (1995).

| | Left | | Right | | Overall | |
|---|---|---|---|---|---|---|
| Subject | $a$ | log $c$ | $a$ | log $c$ | $a$ | log $c$ |
| | | | No COD | | | |
| 11 | 0.09 | 0.41 | 0.25 | -0.11 | 0.65 | 0.15 |
| 12 | 1.04 | -0.06 | 0.51 | 0.04 | 0.64 | 0.11 |
| 13 | 0.17 | 0.28 | 0.98 | 0.20 | 0.68 | 0.07 |
| 14 | 1.43 | 0.65 | 0.53 | -0.43 | 0.74 | -0.25 |
| 15 | 0.32 | 0.11 | 0.35 | 0.14 | 0.31 | 0.10 |
| 16 | 0.76 | -0.20 | 0.91 | -0.11 | 0.78 | -0.21 |
| | | | 2 s COD | | | |
| 11 | -0.27 | 0.54 | 0.22 | -0.50 | 0.85 | -0.07 |
| 12 | -0.38 | 0.65 | 0.89 | -0.24 | 0.98 | -0.09 |
| 13 | 1.07 | -0.11 | 1.25 | 0.31 | 0.80 | 0.06 |
| 14 | 0.51 | 0.12 | 0.44 | -0.26 | 0.78 | -0.04 |
| 15 | 0.89 | -0.05 | 0.48 | -0.05 | 0.69 | 0.03 |
| 16 | 0.46 | 0.10 | 0.08 | -0.27 | 0.64 | -0.07 |
| | | | 4 s COD | | | |
| 11 | 0.51 | 0.41 | 0.62 | -0.28 | 0.99 | 0.01 |
| 12 | -0.10 | 0.68 | 0.77 | -0.07 | 0.94 | 0.07 |
| 13 | 1.30 | -0.10 | 0.97 | 0.20 | 0.93 | 0.16 |
| 14 | 1.20 | -0.24 | 0.71 | -0.56 | 1.05 | -0.21 |
| 15 | 0.50 | 0.37 | 0.59 | -0.18 | 0.93 | 0.02 |
| 16 | 0.69 | 0.00 | 0.98 | 0.05 | 0.84 | -0.05 |

experimental conditions. These will be discussed in turn for both the GML and the C-D model, and in places, Baum et al.'s model.

1. Both the GML and the C-D model fulfilled this criterion. The %VAC by both of these models was above 90% in all cases for both response- (overall and post-COD) and time-allocation data. In addition, analyses of the data from Experiment 4 indicated that the patterns of the deviations of the data from the lines predicted by the two models were similar. While Baum et al.'s model appeared to fit their data well, the failure of Temple et al.'s (1995) data to conform to two separate matching lines suggests that this model, in general, would not provide a good fit for concurrent VI VI schedule data.
2. As the sensitivity to reinforcement parameter ($a$) in the GML increases from 0 to 1.0, behaviour becomes closer to matching, while further increases in $a$ result in overmatching. Therefore, as sensitivity increases, behaviour becomes more extreme. On one level, then, the logic of $a$ appears reasonable. However, the sensitivity parameter was invented because behaviour frequently deviates from matching, and therefore is post-hoc (i.e., there was no a priori reason to expect such a relation). The parameter $d_r$ in the C-D model has logical appeal, in that assumptions about how discriminability might affect behaviour can be made in the absence of data. In this case, as discriminability of the response-reinforcer contingencies (i.e., the schedules of reinforcement associated with each of the discriminative stimuli) improves, the behaviour ratio becomes more similar to the reinforcer-rate ratio. It is easy to see how reduced discriminability could lead to responding which is closer to indifference. However, no provision is made here for explaining behaviour which is more extreme than the reinforcer-rate ratio. The parameter $w$ in the punishment version of the C-D model is described as the

perceived number of reinforcers lost per second due to changing over between the schedules. The logic here is that when a changeover delay (or similar procedure) is in effect, the act of changing over results in time-out from reinforcement. Therefore, the subject has 'lost' reinforcers by essentially taking time-out from the schedules of reinforcement. The parameter *w*, then, seems also to have logical appeal, although when it is to be used raises some questions.

3. While it could be argued that the parameters of the GML were introduced because strict matching was not always found in concurrent VI VI schedule data, these parameters are used in all cases where the model is used. Therefore the inclusion of the parameters is in no way dependent on the individual data set. This is not the case with the C-D model. Only in cases where the original version of the model gives $d_r$ values outside the range 1.0 to $\infty$ from post-COD data, Davison (personal communication) suggests that the punishment version of the model be used instead (i.e., the C-D model with *w* included). Therefore, the inclusion of *w* in the model is based purely on the individual data set. Since post-COD responding does not consistently give values of $d_r$ outside this range, and there is no way of predicting when it will do so, it is difficult to defend the logic of this parameter.
4. The GML's *a* parameter has no restrictions on the possible values. The basic assumption here is simply that there is some type of relation between response and reinforcer-rate ratios. While low or high values of *a* may seem odd, the GML cannot predict what values should be expected (see below). The original version of the C-D model gives reasonable values of $d_r$ most of the time. The only exception is when the data show overmatching (which unfortunately is reasonably common). The punishment version of the C-D model is capable of giving

unreasonable $d_r$ values, and in this case overmatching does not have to be present (although Davison, in a personal communication, suggested that this equation should not be used in such cases). The parameter *w* also sometimes takes on unusual values. In several cases in the present experiments, large negative *w* values were obtained, indicating that large numbers of reinforcers were apparently gained due to changing over. This is not consistent with the logic behind the *w* parameter.

5. The GML is purely a descriptive model. This model cannot predict what effect changes in the experimental conditions should have on the data. On the other hand, the C-D model predicts that changes to the experimental procedure which would be expected to improve the discriminability of the response-reinforcer contingencies should increase the value of *dr*. This has been shown to be the case in experiments which have changed the stimuli associated with the two schedules of reinforcement (Alsop & Davison, 1991; Davison & Jenkins, 1985). However, since the use of the punishment version of the C-D model is supposed to be restricted to those cases where the data require it (Davison, personal communication), this indicates a failure of the model to predict when changing over between the schedules is going to be punishing. Baum et al.'s model appears to make no predictions about the data. This model is suitable only if the subjects' behaviour matches the reinforcer-rate ratio, but gives no indication of the experimental conditions with which this might be expected. Baum et al. do, however, suggest that when matching is not found, a slightly modified version the C-D model (with preferred and non-preferred alternatives replacing left and right alternatives) should be used instead of their model, suggesting that they agree with Davison and his colleagues suggestion that matching is the result of perfect discriminability.

It appears that, while the GML is not ideal for analysing data from experiments employing concurrent VI VI schedules of reinforcement, it is far less problematic than the C-D model. It seems Baum et al.'s model may be of limited value in the analysis of concurrent-schedule behaviour, given that it has been shown here to be unsuitable for the analysis of the limited data sets from possums and hens.

## Conclusion

In conclusion, it has been demonstrated here that concurrent schedules of reinforcement are suitable for the study of possums' behaviour both with and without experimentally introduced biasers. The Generalised Matching Law has been shown to provide a good description of possums' behaviour under concurrent schedules, although it lacks predictive power. While the Contingency-Discriminability model also provided a good description of possums' behaviour, in many cases, it was shown to be unsuitable for the analyses of data where overmatching occurs. The addition of a punishment parameter did not assist in the analysis of such data. Although the theory behind the C-D model suggests that it should be a good predictor of behaviour under concurrent schedules, this was not found to be the case in the present experiments, when either the COD length or the type of reinforcer was manipulated.

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# APPENDIX A

The raw data from the last five sessions from each condition of Experiment 1 are presented for each possum. Total session data is presented from Condition 1. For all other conditions, data is presented separately from the first and second half of the session. The subject (S, 2 = George; 3 = Arthur; 4 = Timmy; 5 = Holly; 6 = Sylvester), condition (C), left responses (RL), right responses (RR), time allocated to the left (TL) and right levers (TR), the reinforcers obtained for responses to the left (RfL) and right levers (RfR), the number of changeovers (CO) the number of responses during the COD on the left (R>L) and right levers (L>R), and the post-reinforcement pause times on the following reinforcers for responses on the left (PTL) and right levers (PTR), are presented.

| | | First Half | | | | | | | | | | | Second Half | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | C | RL | RR | TL | TR | RfL | RfR | CO | R>L | L>R | PTL | PTR | RL | RR | TL | TR | RfL | RfR | CO | R>L | L>R | PTL | PTR |
| 2 | 1 | 690 | 511 | 938 | 1460 | 37 | 38 | 217 | 376 | 131 | | | | | | | | | | | | | |
| 2 | 1 | 666 | 543 | 1002 | 1395 | 40 | 37 | 207 | 355 | 136 | | | | | | | | | | | | | |
| 2 | 1 | 638 | 449 | 842 | 1555 | 39 | 38 | 185 | 345 | 112 | | | | | | | | | | | | | |
| 2 | 1 | 613 | 528 | 865 | 1535 | 39 | 37 | 188 | 363 | 113 | | | | | | | | | | | | | |
| 2 | 1 | 627 | 508 | 926 | 1470 | 39 | 37 | 183 | 322 | 128 | | | | | | | | | | | | | |
| 2 | 2 | 286 | 66 | 1012 | 182 | 37 | 4 | 46 | 68 | 17 | | | 235 | 53 | 1064 | 121 | 36 | 3 | 33 | 43 | 11 | | |
| 2 | 2 | 349 | 80 | 1009 | 181 | 36 | 5 | 55 | 73 | 23 | | | 330 | 85 | 1017 | 182 | 36 | 4 | 58 | 82 | 14 | | |
| 2 | 2 | 348 | 107 | 952 | 240 | 34 | 5 | 64 | 93 | 31 | | | 319 | 91 | 1026 | 174 | 37 | 3 | 50 | 63 | 20 | | |
| 2 | 2 | 157 | 26 | 1125 | 70 | 23 | 1 | 28 | 28 | 5 | | | 111 | 16 | 1134 | 49 | 21 | 1 | 13 | 13 | 4 | | |
| 2 | 2 | 322 | 85 | 1022 | 175 | 36 | 4 | 57 | 66 | 16 | | | 261 | 57 | 1037 | 143 | 32 | 4 | 36 | 45 | 13 | | |
| 2 | 3 | 87 | 176 | 153 | 1040 | 4 | 31 | 34 | 64 | 27 | 55 | 368 | 62 | 162 | 120 | 1080 | 4 | 36 | 26 | 42 | 24 | 41 | 326 |
| 2 | 3 | 48 | 147 | 118 | 1080 | 4 | 32 | 18 | 36 | 12 | 57 | 497 | 95 | 168 | 169 | 1031 | 4 | 37 | 30 | 76 | 24 | 69 | 431 |
| 2 | 3 | 60 | 153 | 126 | 1059 | 3 | 34 | 24 | 44 | 17 | 48 | 559 | 77 | 151 | 171 | 1029 | 4 | 32 | 30 | 51 | 20 | 54 | 461 |
| 2 | 3 | 104 | 202 | 172 | 1022 | 5 | 35 | 36 | 74 | 33 | 56 | 461 | 109 | 208 | 186 | 1014 | 4 | 37 | 38 | 72 | 33 | 59 | 499 |
| 2 | 3 | 53 | 137 | 122 | 1076 | 4 | 27 | 23 | 40 | 17 | 53 | 597 | 59 | 111 | 174 | 1026 | 4 | 32 | 20 | 44 | 13 | 110 | 596 |
| 2 | 4 | 319 | 214 | 561 | 636 | 18 | 21 | 99 | 192 | 84 | 181 | 238 | 310 | 196 | 622 | 578 | 22 | 19 | 93 | 172 | 81 | 173 | 216 |
| 2 | 4 | 264 | 172 | 569 | 621 | 19 | 18 | 86 | 159 | 60 | 215 | 247 | 263 | 165 | 588 | 612 | 19 | 19 | 79 | 149 | 54 | 204 | 244 |
| 2 | 4 | 264 | 181 | 593 | 585 | 20 | 18 | 90 | 156 | 78 | 209 | 225 | 260 | 171 | 578 | 622 | 19 | 20 | 78 | 149 | 71 | 207 | 275 |
| 2 | 4 | 236 | 183 | 484 | 696 | 18 | 19 | 73 | 145 | 64 | 181 | 327 | 216 | 141 | 646 | 554 | 16 | 15 | 62 | 110 | 55 | 322 | 234 |
| 2 | 4 | 238 | 157 | 596 | 600 | 20 | 17 | 71 | 132 | 54 | 293 | 264 | 209 | 130 | 568 | 632 | 15 | 16 | 68 | 116 | 47 | 265 | 309 |
| 3 | 1 | 497 | 659 | 1224 | 1167 | 38 | 38 | 207 | 138 | 331 | | | | | | | | | | | | | |
| 3 | 1 | 538 | 804 | 1200 | 1194 | 41 | 40 | 237 | 189 | 409 | | | | | | | | | | | | | |
| 3 | 1 | 573 | 766 | 1224 | 1173 | 40 | 39 | 217 | 189 | 392 | | | | | | | | | | | | | |
| 3 | 1 | 678 | 887 | 1196 | 1203 | 41 | 42 | 264 | 243 | 453 | | | | | | | | | | | | | |
| 3 | 1 | 709 | 927 | 1180 | 1218 | 42 | 43 | 249 | 241 | 474 | | | | | | | | | | | | | |
| 3 | 2 | 322 | 114 | 1061 | 130 | 39 | 3 | 41 | 50 | 50 | | | 332 | 143 | 1033 | 162 | 33 | 5 | 42 | 56 | 66 | | |
| 3 | 2 | 366 | 154 | 1027 | 172 | 38 | 3 | 48 | 57 | 66 | | | 349 | 205 | 985 | 214 | 38 | 2 | 52 | 65 | 72 | | |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 2 | 329 | 141 | 1019 | 177 | 39 | 3 | 48 | 50 | 42 | | | 301 | 177 | 993 | 195 | 39 | 3 | 46 | 50 | 52 | | |
| 3 | 2 | 277 | 163 | 986 | 212 | 37 | 4 | 46 | 35 | 48 | | | 344 | 212 | 951 | 246 | 38 | 4 | 54 | 67 | 70 | | |
| 3 | 2 | 372 | 198 | 960 | 236 | 35 | 6 | 56 | 64 | 69 | | | 324 | 228 | 927 | 269 | 35 | 4 | 64 | 59 | 72 | | |
| 3 | 3 | 153 | 352 | 265 | 932 | 3 | 38 | 60 | 62 | 69 | 19 | 164 | 124 | 381 | 278 | 922 | 7 | 38 | 52 | 54 | 86 | 52 | 137 |
| 3 | 3 | 156 | 323 | 289 | 890 | 5 | 36 | 62 | 67 | 69 | 50 | 151 | 160 | 331 | 295 | 905 | 4 | 35 | 65 | 60 | 72 | 40 | 119 |
| 3 | 3 | 147 | 368 | 260 | 937 | 5 | 35 | 70 | 67 | 86 | 49 | 126 | 137 | 370 | 261 | 939 | 4 | 39 | 76 | 70 | 102 | 25 | 122 |
| 3 | 3 | 136 | 393 | 218 | 982 | 4 | 34 | 69 | 79 | 117 | 21 | 73 | 150 | 382 | 251 | 949 | 4 | 36 | 76 | 88 | 127 | 17 | 89 |
| 3 | 3 | 145 | 416 | 249 | 941 | 3 | 38 | 72 | 77 | 101 | 24 | 126 | 150 | 342 | 372 | 828 | 7 | 34 | 81 | 74 | 111 | 61 | 99 |
| 3 | 4 | 281 | 227 | 704 | 477 | 18 | 19 | 65 | 82 | 111 | 222 | 161 | 281 | 211 | 719 | 481 | 19 | 17 | 68 | 76 | 83 | 153 | 135 |
| 3 | 4 | 279 | 244 | 685 | 515 | 21 | 20 | 75 | 99 | 115 | 158 | 120 | 292 | 265 | 641 | 559 | 20 | 21 | 63 | 81 | 103 | 157 | 141 |
| 3 | 4 | 320 | 203 | 653 | 546 | 18 | 20 | 72 | 96 | 70 | 168 | 188 | 291 | 290 | 585 | 615 | 20 | 20 | 78 | 103 | 83 | 143 | 102 |
| 3 | 4 | 286 | 303 | 599 | 599 | 20 | 22 | 76 | 101 | 109 | 157 | 123 | 349 | 307 | 661 | 539 | 18 | 18 | 84 | 118 | 126 | 138 | 86 |
| 3 | 4 | 228 | 194 | 598 | 600 | 18 | 18 | 79 | 85 | 63 | 190 | 225 | 215 | 155 | 673 | 527 | 18 | 18 | 74 | 81 | 63 | 279 | 208 |
| 4 | 1 | 716 | 585 | 1153 | 1247 | 27 | 28 | 139 | 298 | 275 | | | | | | | | | | | | | |
| 4 | 1 | 780 | 615 | 1177 | 1216 | 33 | 33 | 139 | 305 | 289 | | | | | | | | | | | | | |
| 4 | 1 | 728 | 517 | 1220 | 1177 | 34 | 33 | 146 | 296 | 266 | | | | | | | | | | | | | |
| 4 | 1 | 509 | 439 | 1191 | 1209 | 31 | 31 | 123 | 206 | 227 | | | | | | | | | | | | | |
| 4 | 1 | 601 | 479 | 1108 | 1273 | 30 | 32 | 128 | 226 | 255 | | | | | | | | | | | | | |
| 4 | 2 | 156 | 40 | 1045 | 82 | 31 | 3 | 20 | 14 | 19 | | | 87 | 20 | 1140 | 47 | 26 | 2 | 8 | 6 | 10 | | |
| 4 | 2 | 142 | 39 | 1081 | 111 | 30 | 4 | 16 | 7 | 24 | | | 123 | 31 | 1109 | 65 | 26 | 2 | 16 | 20 | 18 | | |
| 4 | 2 | 127 | 33 | 1035 | 141 | 28 | 2 | 14 | 14 | 16 | | | 152 | 71 | 1085 | 103 | 30 | 2 | 24 | 29 | 39 | | |
| 4 | 2 | 45 | 13 | 1127 | 40 | 6 | 1 | 6 | 5 | 8 | | | 20 | 0 | 583 | 0 | 4 | 0 | 0 | 0 | 0 | | |
| 4 | 2 | 70 | 22 | 1124 | 72 | 12 | 2 | 8 | 3 | 12 | | | 86 | 24 | 1104 | 61 | 23 | 2 | 8 | 7 | 14 | | |
| 4 | 3 | 74 | 169 | 140 | 1034 | 4 | 31 | 30 | 56 | 62 | 80 | 593 | 73 | 151 | 121 | 1079 | 4 | 30 | 22 | 48 | 34 | 71 | 490 |
| 4 | 3 | 92 | 170 | 182 | 876 | 5 | 28 | 34 | 63 | 54 | 112 | 460 | 49 | 117 | 95 | 1105 | 4 | 31 | 20 | 37 | 24 | 46 | 365 |
| 4 | 3 | 87 | 182 | 139 | 1057 | 4 | 32 | 35 | 62 | 53 | 64 | 615 | 89 | 209 | 103 | 1097 | 2 | 32 | 29 | 53 | 62 | 33 | 571 |
| 4 | 3 | 113 | 262 | 140 | 1013 | 3 | 30 | 38 | 69 | 84 | 62 | 609 | 79 | 213 | 105 | 1095 | 4 | 34 | 26 | 58 | 48 | 52 | 625 |
| 4 | 3 | 101 | 228 | 142 | 1052 | 4 | 32 | 30 | 68 | 62 | 77 | 578 | 66 | 138 | 113 | 1087 | 3 | 30 | 32 | 48 | 51 | 48 | 695 |
| 4 | 4 | 171 | 195 | 541 | 654 | 14 | 15 | 52 | 95 | 119 | 356 | 425 | 197 | 183 | 579 | 621 | 16 | 17 | 70 | 124 | 119 | 354 | 372 |
| 4 | 4 | 232 | 187 | 629 | 551 | 16 | 16 | 63 | 136 | 117 | 383 | 324 | 196 | 212 | 648 | 552 | 17 | 15 | 66 | 122 | 133 | 435 | 264 |
| 4 | 4 | 229 | 207 | 565 | 632 | 15 | 15 | 72 | 144 | 128 | 325 | 317 | 187 | 164 | 536 | 664 | 16 | 15 | 54 | 129 | 87 | 353 | 345 |
| 4 | 4 | 202 | 171 | 515 | 668 | 16 | 16 | 65 | 125 | 103 | 328 | 359 | 226 | 260 | 571 | 629 | 17 | 18 | 73 | 138 | 152 | 321 | 305 |
| 4 | 4 | 219 | 205 | 592 | 599 | 15 | 16 | 66 | 114 | 120 | 332 | 357 | 199 | 157 | 528 | 672 | 12 | 13 | 64 | 119 | 97 | 293 | 314 |
| 5 | 1 | 194 | 166 | 1760 | 621 | 17 | 15 | 55 | 119 | 35 | | | | | | | | | | | | | |
| 5 | 1 | 363 | 288 | 1447 | 945 | 24 | 25 | 95 | 187 | 66 | | | | | | | | | | | | | |
| 5 | 1 | 452 | 369 | 1404 | 989 | 29 | 29 | 117 | 239 | 73 | | | | | | | | | | | | | |
| 5 | 1 | 649 | 530 | 1232 | 1167 | 35 | 36 | 148 | 331 | 117 | | | | | | | | | | | | | |
| 5 | 1 | 548 | 434 | 1297 | 1099 | 32 | 33 | 146 | 303 | 99 | | | | | | | | | | | | | |
| 5 | 2 | 175 | 41 | 1135 | 58 | 30 | 1 | 14 | 24 | 5 | | | 96 | 30 | 542 | 45 | 16 | 1 | 10 | 18 | 5 | | |
| 5 | 2 | 186 | 19 | 1126 | 56 | 33 | 2 | 8 | 12 | 7 | | | 89 | 4 | 1124 | 44 | 16 | 2 | 4 | 1 | 0 | | |
| 5 | 2 | 200 | 38 | 1118 | 72 | 32 | 2 | 18 | 13 | 15 | | | 109 | 13 | 1137 | 42 | 16 | 2 | 8 | 6 | 6 | | |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 2 | 142 | 23 | 534 | 57 | 13 | 2 | 12 | 21 | 10 | | | 50 | 3 | 558 | 22 | 14 | 1 | 2 | 0 | 1 | |
| 5 | 2 | 110 | 16 | 539 | 60 | 15 | 2 | 8 | 10 | 7 | | | 19 | 0 | 580 | 0 | 9 | 0 | 0 | 0 | 0 | |
| 5 | 3 | 65 | 182 | 236 | 962 | 5 | 32 | 37 | 40 | 47 | 116 | 581 | 14 | 52 | 50 | 1150 | 1 | 12 | 8 | 7 | 8 | 23 | 233 |
| 5 | 3 | 51 | 157 | 143 | 1053 | 3 | 33 | 29 | 31 | 33 | 39 | 650 | 29 | 97 | 180 | 1020 | 3 | 26 | 13 | 14 | 15 | 125 | 637 |
| 5 | 3 | 61 | 158 | 159 | 1032 | 3 | 31 | 28 | 31 | 34 | 50 | 610 | 24 | 95 | 91 | 1109 | 2 | 27 | 12 | 14 | 17 | 41 | 801 |
| 5 | 3 | 14 | 49 | 86 | 1066 | 2 | 16 | 6 | 9 | 7 | 66 | 476 | 0 | 5 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 3 | 24 | 95 | 60 | 1140 | 1 | 28 | 13 | 13 | 20 | 23 | 689 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 4 | 114 | 100 | 675 | 516 | 13 | 14 | 39 | 48 | 50 | 455 | 333 | 86 | 90 | 679 | 521 | 13 | 14 | 38 | 53 | 43 | 542 | 377 |
| 5 | 4 | 116 | 110 | 588 | 554 | 12 | 12 | 38 | 55 | 50 | 367 | 401 | 31 | 44 | 300 | 900 | 5 | 6 | 13 | 14 | 22 | 190 | 810 |
| 5 | 4 | 121 | 142 | 571 | 577 | 14 | 14 | 47 | 65 | 69 | 395 | 401 | 78 | 55 | 505 | 695 | 12 | 9 | 23 | 33 | 26 | 380 | 611 |
| 5 | 4 | 104 | 97 | 423 | 728 | 10 | 11 | 38 | 52 | 58 | 243 | 454 | 8 | 12 | 49 | 1151 | 1 | 1 | 4 | 6 | 8 | 33 | 621 |
| 5 | 4 | 159 | 142 | 611 | 574 | 15 | 15 | 52 | 82 | 72 | 398 | 364 | 109 | 123 | 460 | 740 | 13 | 14 | 39 | 58 | 48 | 303 | 537 |
| 6 | 1 | 604 | 609 | 1323 | 1075 | 24 | 22 | 98 | 256 | 207 | | | | | | | | | | | | | |
| 6 | 1 | 532 | 512 | 1702 | 696 | 23 | 21 | 103 | 271 | 179 | | | | | | | | | | | | | |
| 6 | 1 | 897 | 904 | 1069 | 1330 | 33 | 32 | 165 | 394 | 371 | | | | | | | | | | | | | |
| 6 | 1 | 853 | 873 | 868 | 1529 | 31 | 31 | 172 | 429 | 316 | | | | | | | | | | | | | |
| 6 | 1 | 773 | 961 | 940 | 1457 | 32 | 32 | 175 | 383 | 384 | | | | | | | | | | | | | |
| 6 | 2 | 406 | 26 | 534 | 64 | 16 | 3 | 18 | 42 | 12 | | | 212 | 19 | 551 | 37 | 16 | 1 | 10 | 25 | 12 | | |
| 6 | 2 | 554 | 67 | 886 | 67 | 29 | 2 | 25 | 72 | 34 | | | 266 | 41 | 1112 | 79 | 19 | 2 | 13 | 39 | 11 | | |
| 6 | 2 | 531 | 133 | 1094 | 104 | 34 | 2 | 41 | 120 | 47 | | | 214 | 65 | 552 | 48 | 17 | 1 | 16 | 48 | 25 | | |
| 6 | 2 | 491 | 25 | 1092 | 77 | 32 | 3 | 20 | 48 | 8 | | | 517 | 44 | 1125 | 60 | 26 | 2 | 30 | 87 | 22 | | |
| 6 | 2 | 657 | 123 | 1024 | 169 | 33 | 5 | 50 | 157 | 67 | | | 359 | 42 | 1107 | 55 | 20 | 1 | 22 | 69 | 20 | | |
| 6 | 3 | 153 | 291 | 112 | 1088 | 4 | 37 | 38 | 125 | 52 | 36 | 437 | 156 | 198 | 124 | 1076 | 5 | 29 | 42 | 119 | 45 | 36 | 328 |
| 6 | 3 | 185 | 382 | 111 | 1089 | 4 | 36 | 40 | 139 | 68 | 33 | 386 | 94 | 198 | 80 | 1120 | 4 | 26 | 24 | 74 | 32 | 33 | 292 |
| 6 | 3 | 145 | 380 | 110 | 1089 | 5 | 34 | 38 | 116 | 56 | 48 | 371 | 64 | 147 | 70 | 1130 | 3 | 19 | 14 | 33 | 19 | 22 | 203 |
| 6 | 3 | 168 | 394 | 97 | 1103 | 5 | 36 | 39 | 131 | 47 | 31 | 396 | 57 | 149 | 62 | 1138 | 2 | 25 | 13 | 44 | 19 | 32 | 275 |
| 6 | 3 | 161 | 402 | 125 | 1075 | 6 | 35 | 40 | 127 | 48 | 53 | 363 | 122 | 200 | 82 | 1118 | 4 | 30 | 26 | 91 | 34 | 27 | 417 |
| 6 | 4 | 541 | 621 | 522 | 677 | 18 | 18 | 98 | 364 | 190 | 129 | 146 | 299 | 331 | 367 | 833 | 14 | 13 | 57 | 189 | 115 | 147 | 141 |
| 6 | 4 | 433 | 430 | 532 | 665 | 18 | 18 | 77 | 265 | 148 | 144 | 182 | 64 | 56 | 301 | 899 | 6 | 4 | 13 | 44 | 20 | 68 | 82 |
| 6 | 4 | 596 | 546 | 488 | 712 | 20 | 19 | 107 | 388 | 216 | 162 | 168 | 371 | 344 | 360 | 840 | 15 | 18 | 67 | 211 | 144 | 123 | 273 |
| 6 | 4 | 144 | 138 | 308 | 878 | 6 | 6 | 30 | 91 | 47 | 193 | 60 | 9 | 15 | 40 | 1160 | 1 | 3 | 4 | 8 | 3 | 14 | 33 |
| 6 | 4 | 525 | 489 | 471 | 728 | 20 | 20 | 93 | 314 | 181 | 168 | 193 | 196 | 191 | 199 | 1001 | 6 | 8 | 37 | 110 | 73 | 94 | 77 |

# APPENDIX B

The raw data from the last five sessions from each condition of Experiment 2 are presented for each possum. Data is presented separately from the first and second half of the session. The subject (S, 7 = Static; 8 = Jasper; 9 = Izzie; 10 = Benny; 11 = Emma; 12 = Putzy), condition (C), left responses (RL), right responses (RR), time allocated to the left (TL) and right levers (TR), the reinforcers obtained for responses to the left (RfL) and right levers (RfR), the number of changeovers (CO) the number of responses during the COD on the left (R>L) and right levers (L>R), and the post-reinforcement pause times on the following reinforcers for responses on the left (PTL) and right levers (PTR), are presented.

| | | | First half | | | | | | | | | | | Second half | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | C | L | RL | RR | TL | TR | RfL | RfR | CO | R>L | L>R | PTL | PTR | RL | RR | TL | TR | RfL | RfR | CO | R>L | L>R | PTL | PTR |
| 7 | 1 | 0 | 127 | 156 | 606 | 594 | 16 | 19 | 94 | 47 | 47 | 285 | 320 | 30 | 34 | 535 | 665 | 7 | 7 | 22 | 11 | 11 | 165 | 626 |
| 7 | 1 | 0 | 93 | 119 | 712 | 487 | 14 | 15 | 70 | 35 | 35 | 407 | 310 | 15 | 24 | 523 | 677 | 5 | 6 | 13 | 7 | 6 | 335 | 645 |
| 7 | 1 | 0 | 210 | 246 | 577 | 623 | 20 | 21 | 157 | 79 | 78 | 229 | 296 | 147 | 92 | 426 | 774 | 10 | 8 | 58 | 123 | 31 | 210 | 481 |
| 7 | 1 | 0 | 120 | 130 | 498 | 702 | 12 | 14 | 80 | 40 | 40 | 255 | 440 | 21 | 17 | 749 | 451 | 4 | 2 | 13 | 7 | 6 | 232 | 401 |
| 7 | 1 | 0 | 126 | 182 | 630 | 570 | 17 | 16 | 95 | 48 | 47 | 300 | 267 | 12 | 8 | 1104 | 96 | 1 | 1 | 8 | 4 | 4 | 22 | 89 |
| 7 | 2 | 0 | 100 | 296 | 170 | 1030 | 4 | 39 | 66 | 33 | 33 | 70 | 525 | 35 | 108 | 74 | 1126 | 1 | 19 | 28 | 14 | 14 | 10 | 317 |
| 7 | 2 | 0 | 46 | 304 | 92 | 1108 | 3 | 34 | 39 | 20 | 19 | 44 | 523 | 22 | 113 | 133 | 1067 | 3 | 26 | 21 | 10 | 11 | 62 | 791 |
| 7 | 2 | 0 | 81 | 270 | 185 | 1015 | 5 | 38 | 65 | 33 | 32 | 56 | 584 | 23 | 73 | 188 | 1012 | 3 | 17 | 19 | 9 | 10 | 117 | 802 |
| 7 | 2 | 0 | 72 | 284 | 125 | 1075 | 4 | 37 | 57 | 29 | 28 | 50 | 611 | 21 | 103 | 78 | 1122 | 1 | 20 | 16 | 8 | 8 | 41 | 384 |
| 7 | 2 | 0 | 75 | 328 | 147 | 1053 | 5 | 37 | 54 | 27 | 27 | 75 | 542 | 14 | 49 | 309 | 891 | 2 | 15 | 10 | 5 | 5 | 287 | 690 |
| 7 | 3 | 0 | 271 | 136 | 905 | 295 | 35 | 5 | 99 | 50 | 49 | 517 | 88 | 111 | 44 | 1012 | 188 | 26 | 4 | 34 | 17 | 17 | 614 | 72 |
| 7 | 3 | 0 | 239 | 114 | 927 | 272 | 38 | 5 | 88 | 44 | 44 | 591 | 96 | 159 | 60 | 1042 | 158 | 26 | 4 | 50 | 25 | 25 | 504 | 74 |
| 7 | 3 | 0 | 260 | 110 | 975 | 225 | 37 | 5 | 84 | 42 | 42 | 540 | 73 | 103 | 28 | 1092 | 108 | 20 | 3 | 24 | 12 | 12 | 725 | 49 |
| 7 | 3 | 0 | 212 | 94 | 958 | 242 | 36 | 4 | 70 | 35 | 35 | 586 | 74 | 130 | 54 | 1053 | 147 | 32 | 4 | 40 | 20 | 20 | 669 | 79 |
| 7 | 3 | 0 | 248 | 119 | 951 | 249 | 36 | 3 | 87 | 43 | 44 | 591 | 42 | 159 | 64 | 982 | 218 | 33 | 5 | 51 | 26 | 25 | 668 | 78 |
| 7 | 4 | 0 | 168 | 430 | 202 | 998 | 10 | 35 | 128 | 64 | 64 | 101 | 375 | 127 | 293 | 202 | 998 | 8 | 35 | 92 | 46 | 46 | 107 | 506 |
| 7 | 4 | 0 | 168 | 382 | 250 | 950 | 10 | 35 | 130 | 65 | 65 | 154 | 432 | 135 | 298 | 162 | 1038 | 7 | 34 | 107 | 54 | 53 | 77 | 554 |
| 7 | 4 | 0 | 131 | 300 | 201 | 999 | 8 | 34 | 100 | 50 | 50 | 120 | 521 | 94 | 190 | 208 | 992 | 8 | 31 | 72 | 36 | 36 | 133 | 642 |
| 7 | 4 | 0 | 173 | 372 | 221 | 979 | 10 | 36 | 130 | 65 | 65 | 116 | 407 | 68 | 146 | 293 | 907 | 5 | 32 | 52 | 26 | 26 | 107 | 555 |
| 7 | 4 | 0 | 151 | 350 | 229 | 971 | 10 | 36 | 120 | 60 | 60 | 104 | 432 | 73 | 191 | 201 | 999 | 7 | 31 | 58 | 29 | 29 | 122 | 567 |
| 7 | 5 | 0 | 245 | 124 | 863 | 337 | 33 | 9 | 88 | 44 | 44 | 433 | 137 | 145 | 68 | 935 | 265 | 23 | 5 | 60 | 30 | 30 | 416 | 128 |
| 7 | 5 | 0 | 258 | 179 | 777 | 423 | 34 | 7 | 119 | 59 | 60 | 441 | 102 | 86 | 49 | 564 | 636 | 17 | 4 | 33 | 17 | 16 | 329 | 79 |
| 7 | 5 | 0 | 253 | 149 | 833 | 367 | 32 | 9 | 108 | 54 | 54 | 417 | 142 | 112 | 67 | 933 | 267 | 28 | 6 | 52 | 26 | 26 | 707 | 133 |
| 7 | 5 | 0 | 225 | 152 | 869 | 331 | 36 | 7 | 102 | 51 | 51 | 533 | 84 | 144 | 76 | 876 | 324 | 24 | 8 | 58 | 29 | 29 | 612 | 185 |
| 7 | 5 | 0 | 193 | 107 | 913 | 287 | 32 | 6 | 72 | 36 | 36 | 463 | 109 | 51 | 29 | 766 | 434 | 15 | 5 | 22 | 11 | 11 | 648 | 366 |
| 7 | 6 | 0 | 194 | 248 | 524 | 676 | 20 | 19 | 125 | 62 | 63 | 287 | 288 | 87 | 130 | 613 | 587 | 15 | 15 | 64 | 32 | 32 | 386 | 323 |
| 7 | 6 | 0 | 190 | 293 | 454 | 746 | 20 | 21 | 130 | 65 | 65 | 281 | 320 | 114 | 169 | 635 | 565 | 19 | 18 | 81 | 41 | 40 | 457 | 332 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 6 | 0 | 183 | 298 | 515 | 685 | 22 | 21 | 134 | 67 | 67 | 312 | 285 | 138 | 179 | 604 | 596 | 17 | 18 | 96 | 48 | 48 | 390 | 364 |
| 7 | 6 | 0 | 169 | 231 | 590 | 610 | 21 | 20 | 115 | 57 | 58 | 369 | 300 | 115 | 139 | 643 | 557 | 17 | 17 | 80 | 40 | 40 | 400 | 397 |
| 7 | 6 | 0 | 198 | 286 | 542 | 658 | 19 | 21 | 134 | 67 | 67 | 299 | 297 | 158 | 216 | 566 | 634 | 21 | 19 | 107 | 54 | 53 | 393 | 367 |
| 7 | 7 | 2 | 229 | 289 | 570 | 630 | 17 | 18 | 92 | 160 | 163 | 325 | 316 | 215 | 170 | 650 | 550 | 16 | 16 | 77 | 164 | 110 | 376 | 350 |
| 7 | 7 | 2 | 212 | 214 | 534 | 666 | 16 | 18 | 77 | 159 | 124 | 357 | 398 | 183 | 184 | 593 | 607 | 16 | 15 | 64 | 121 | 107 | 397 | 405 |
| 7 | 7 | 2 | 193 | 227 | 545 | 655 | 18 | 17 | 78 | 148 | 139 | 374 | 352 | 136 | 147 | 553 | 647 | 14 | 13 | 51 | 103 | 87 | 393 | 371 |
| 7 | 7 | 2 | 221 | 236 | 520 | 680 | 16 | 17 | 88 | 161 | 141 | 293 | 311 | 179 | 166 | 595 | 605 | 12 | 12 | 66 | 131 | 103 | 379 | 335 |
| 7 | 7 | 2 | 180 | 213 | 583 | 617 | 17 | 15 | 65 | 129 | 110 | 377 | 299 | 173 | 198 | 578 | 622 | 16 | 15 | 61 | 119 | 108 | 395 | 345 |
| 7 | 8 | 2 | 69 | 232 | 116 | 1084 | 4 | 35 | 26 | 49 | 44 | 62 | 444 | 59 | 168 | 116 | 1084 | 3 | 34 | 24 | 37 | 45 | 61 | 622 |
| 7 | 8 | 2 | 65 | 230 | 106 | 1094 | 4 | 33 | 27 | 48 | 53 | 48 | 469 | 48 | 184 | 89 | 1111 | 3 | 34 | 19 | 34 | 35 | 54 | 566 |
| 7 | 8 | 2 | 64 | 220 | 115 | 1085 | 4 | 34 | 26 | 40 | 49 | 63 | 501 | 35 | 153 | 102 | 1098 | 4 | 31 | 16 | 24 | 25 | 66 | 573 |
| 7 | 8 | 2 | 66 | 276 | 88 | 1112 | 3 | 34 | 32 | 50 | 64 | 34 | 507 | 27 | 124 | 87 | 1113 | 4 | 30 | 12 | 20 | 13 | 60 | 547 |
| 7 | 8 | 2 | 68 | 185 | 147 | 1053 | 5 | 32 | 28 | 43 | 50 | 86 | 515 | 5 | 41 | 19 | 1181 | 1 | 16 | 4 | 4 | 2 | 9 | 900 |
| 7 | 9 | 2 | 243 | 97 | 1094 | 106 | 34 | 3 | 32 | 27 | 66 | 469 | 36 | 183 | 66 | 1090 | 110 | 30 | 5 | 21 | 13 | 48 | 573 | 58 |
| 7 | 9 | 2 | 215 | 87 | 1072 | 128 | 32 | 5 | 32 | 30 | 66 | 478 | 52 | 189 | 41 | 1106 | 94 | 31 | 4 | 14 | 13 | 34 | 592 | 61 |
| 7 | 9 | 2 | 187 | 62 | 1110 | 90 | 33 | 3 | 18 | 16 | 43 | 576 | 42 | 190 | 45 | 1111 | 89 | 33 | 4 | 18 | 14 | 38 | 569 | 49 |
| 7 | 9 | 2 | 208 | 47 | 1091 | 109 | 33 | 4 | 18 | 12 | 37 | 458 | 57 | 189 | 23 | 1150 | 50 | 33 | 2 | 14 | 10 | 20 | 625 | 28 |
| 7 | 9 | 2 | 204 | 66 | 1081 | 119 | 34 | 5 | 26 | 17 | 48 | 423 | 60 | 191 | 43 | 1118 | 82 | 36 | 3 | 14 | 10 | 30 | 598 | 53 |
| 7 | 10 | 2 | 107 | 249 | 257 | 943 | 8 | 27 | 60 | 69 | 101 | 110 | 416 | 68 | 188 | 206 | 994 | 6 | 27 | 43 | 40 | 65 | 93 | 482 |
| 7 | 10 | 2 | 55 | 168 | 167 | 1033 | 6 | 32 | 32 | 33 | 47 | 90 | 548 | 53 | 110 | 244 | 956 | 7 | 22 | 36 | 33 | 38 | 127 | 577 |
| 7 | 10 | 2 | 75 | 188 | 255 | 945 | 9 | 27 | 47 | 43 | 62 | 135 | 444 | 27 | 101 | 156 | 1044 | 6 | 26 | 20 | 15 | 30 | 112 | 543 |
| 7 | 10 | 2 | 58 | 175 | 236 | 964 | 7 | 28 | 44 | 39 | 74 | 139 | 529 | 32 | 115 | 166 | 1034 | 4 | 24 | 24 | 14 | 39 | 56 | 600 |
| 7 | 10 | 2 | 72 | 218 | 219 | 981 | 7 | 27 | 52 | 49 | 86 | 111 | 479 | 36 | 130 | 196 | 1004 | 6 | 22 | 28 | 25 | 34 | 126 | 549 |
| 7 | 11 | 2 | 200 | 134 | 955 | 245 | 28 | 8 | 42 | 39 | 98 | 417 | 103 | 126 | 57 | 1051 | 149 | 25 | 6 | 22 | 16 | 46 | 629 | 93 |
| 7 | 11 | 2 | 208 | 114 | 993 | 207 | 29 | 8 | 36 | 35 | 82 | 421 | 93 | 63 | 29 | 1106 | 94 | 18 | 3 | 10 | 9 | 20 | 414 | 59 |
| 7 | 11 | 2 | 203 | 107 | 1022 | 178 | 29 | 7 | 35 | 29 | 81 | 404 | 68 | 102 | 46 | 1048 | 152 | 26 | 5 | 17 | 20 | 35 | 611 | 95 |
| 7 | 11 | 2 | 255 | 153 | 954 | 246 | 29 | 9 | 46 | 45 | 111 | 407 | 118 | 66 | 42 | 1100 | 100 | 13 | 3 | 14 | 16 | 29 | 283 | 57 |
| 7 | 11 | 2 | 206 | 123 | 1001 | 199 | 30 | 5 | 38 | 51 | 83 | 475 | 65 | 75 | 42 | 1050 | 150 | 12 | 4 | 18 | 23 | 35 | 264 | 76 |
| 7 | 12 | 2 | 0 | 76 | 0 | 1201 | 0 | 29 | 0 | 0 | 0 | 0 | 811 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 |
| 7 | 12 | 2 | 0 | 145 | 0 | 1200 | 0 | 39 | 0 | 0 | 0 | 0 | 647 | 0 | 25 | 0 | 1200 | 0 | 11 | 0 | 0 | 0 | 0 | 765 |
| 7 | 12 | 2 | 0 | 65 | 0 | 1200 | 0 | 32 | 0 | 0 | 0 | 0 | 822 | 0 | 3 | 0 | 1200 | 0 | 1 | 0 | 0 | 0 | 0 | 754 |
| 7 | 12 | 2 | 0 | 100 | 1 | 1199 | 0 | 32 | 0 | 0 | 0 | 0 | 555 | 0 | 4 | 0 | 1200 | 0 | 2 | 0 | 0 | 0 | 0 | 63 |
| 7 | 12 | 2 | 0 | 144 | 0 | 1200 | 0 | 37 | 0 | 0 | 0 | 0 | 594 | 0 | 41 | 0 | 1200 | 0 | 19 | 0 | 0 | 0 | 0 | 532 |
| 7 | 13 | 2 | 202 | 292 | 473 | 727 | 14 | 15 | 72 | 123 | 123 | 264 | 262 | 129 | 157 | 589 | 611 | 14 | 14 | 52 | 72 | 74 | 426 | 398 |
| 7 | 13 | 2 | 159 | 182 | 522 | 678 | 15 | 15 | 56 | 100 | 76 | 355 | 336 | 106 | 110 | 535 | 665 | 14 | 14 | 45 | 63 | 47 | 403 | 433 |
| 7 | 13 | 2 | 175 | 162 | 561 | 639 | 16 | 16 | 62 | 100 | 81 | 381 | 323 | 113 | 127 | 530 | 670 | 14 | 14 | 50 | 72 | 68 | 412 | 477 |
| 7 | 13 | 2 | 150 | 202 | 523 | 677 | 17 | 18 | 70 | 88 | 104 | 321 | 318 | 59 | 88 | 598 | 602 | 10 | 8 | 31 | 40 | 39 | 516 | 405 |
| 7 | 13 | 2 | 164 | 212 | 553 | 647 | 15 | 16 | 64 | 91 | 94 | 376 | 321 | 151 | 180 | 504 | 696 | 15 | 15 | 66 | 85 | 91 | 320 | 318 |
| 7 | 14 | 4 | 259 | 209 | 525 | 675 | 16 | 15 | 55 | 190 | 103 | 289 | 282 | 218 | 148 | 517 | 683 | 16 | 15 | 42 | 170 | 69 | 327 | 307 |
| 7 | 14 | 4 | 266 | 215 | 495 | 705 | 14 | 15 | 48 | 194 | 99 | 265 | 312 | 162 | 131 | 527 | 673 | 15 | 12 | 39 | 130 | 53 | 350 | 309 |
| 7 | 14 | 4 | 182 | 125 | 503 | 697 | 15 | 17 | 38 | 133 | 50 | 339 | 357 | 205 | 145 | 526 | 674 | 14 | 13 | 44 | 151 | 75 | 308 | 331 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 14 | 4 | 260 | 180 | 536 | 664 | 14 | 14 | 49 | 168 | 100 | 284 | 307 | 88 | 61 | 360 | 840 | 9 | 8 | 27 | 73 | 28 | 248 | 653 |
| 7 | 14 | 4 | 217 | 170 | 561 | 639 | 14 | 14 | 54 | 148 | 99 | 307 | 313 | 114 | 123 | 759 | 441 | 10 | 9 | 33 | 72 | 66 | 595 | 219 |
| 7 | 15 | 4 | 24 | 136 | 104 | 1096 | 4 | 29 | 8 | 20 | 4 | 75 | 541 | 39 | 117 | 108 | 1092 | 3 | 26 | 12 | 30 | 16 | 58 | 677 |
| 7 | 15 | 4 | 49 | 181 | 138 | 1062 | 3 | 29 | 14 | 32 | 22 | 53 | 543 | 27 | 115 | 78 | 1122 | 2 | 32 | 6 | 16 | 10 | 48 | 688 |
| 7 | 15 | 4 | 40 | 171 | 111 | 1089 | 4 | 30 | 11 | 28 | 14 | 69 | 548 | 69 | 120 | 213 | 987 | 5 | 28 | 15 | 37 | 28 | 102 | 564 |
| 7 | 15 | 4 | 41 | 139 | 108 | 1092 | 4 | 32 | 10 | 30 | 8 | 64 | 577 | 37 | 109 | 107 | 1093 | 3 | 31 | 12 | 28 | 14 | 69 | 643 |
| 7 | 15 | 4 | 62 | 172 | 128 | 1072 | 4 | 31 | 16 | 41 | 22 | 58 | 502 | 65 | 172 | 138 | 1062 | 4 | 30 | 18 | 40 | 44 | 70 | 590 |
| 7 | 16 | 4 | 146 | 38 | 1102 | 98 | 32 | 2 | 12 | 13 | 33 | 406 | 20 | 68 | 19 | 1157 | 43 | 18 | 2 | 4 | 3 | 17 | 385 | 28 |
| 7 | 16 | 4 | 196 | 118 | 1017 | 183 | 28 | 5 | 24 | 24 | 93 | 352 | 69 | 124 | 54 | 1107 | 93 | 32 | 3 | 14 | 23 | 46 | 707 | 47 |
| 7 | 16 | 4 | 260 | 129 | 1020 | 180 | 32 | 4 | 46 | 100 | 100 | 443 | 38 | 112 | 40 | 1092 | 108 | 26 | 4 | 8 | 8 | 36 | 790 | 79 |
| 7 | 16 | 4 | 184 | 35 | 1138 | 62 | 34 | 2 | 10 | 6 | 31 | 459 | 19 | 132 | 59 | 1054 | 146 | 28 | 5 | 14 | 23 | 53 | 634 | 98 |
| 7 | 16 | 4 | 179 | 54 | 1100 | 100 | 32 | 3 | 12 | 13 | 47 | 532 | 41 | 31 | 25 | 1173 | 27 | 4 | 0 | 8 | 8 | 19 | 74 | 0 |
| 7 | 17 | 4 | 86 | 182 | 176 | 1024 | 6 | 26 | 18 | 62 | 28 | 98 | 559 | 54 | 127 | 204 | 996 | 6 | 25 | 16 | 42 | 25 | 142 | 592 |
| 7 | 17 | 4 | 95 | 211 | 179 | 1021 | 6 | 27 | 24 | 66 | 54 | 91 | 445 | 61 | 144 | 198 | 1002 | 7 | 22 | 17 | 54 | 26 | 135 | 610 |
| 7 | 17 | 4 | 103 | 268 | 187 | 1013 | 6 | 27 | 28 | 69 | 71 | 86 | 457 | 73 | 125 | 211 | 989 | 7 | 23 | 20 | 54 | 32 | 138 | 584 |
| 7 | 17 | 4 | 104 | 215 | 195 | 1005 | 6 | 28 | 26 | 70 | 62 | 89 | 407 | 95 | 171 | 229 | 971 | 7 | 25 | 28 | 68 | 60 | 126 | 466 |
| 7 | 17 | 4 | 51 | 195 | 152 | 1047 | 7 | 27 | 18 | 42 | 19 | 90 | 462 | 78 | 145 | 196 | 1004 | 6 | 26 | 24 | 53 | 55 | 113 | 556 |
| 7 | 18 | 4 | 174 | 109 | 1013 | 187 | 24 | 7 | 21 | 21 | 91 | 370 | 85 | 123 | 76 | 1015 | 185 | 26 | 6 | 17 | 17 | 65 | 535 | 122 |
| 7 | 18 | 4 | 190 | 90 | 1073 | 127 | 29 | 5 | 18 | 22 | 73 | 502 | 51 | 122 | 100 | 996 | 204 | 24 | 8 | 22 | 20 | 85 | 539 | 116 |
| 7 | 18 | 4 | 273 | 148 | 992 | 208 | 29 | 5 | 28 | 65 | 117 | 476 | 83 | 179 | 129 | 953 | 247 | 23 | 8 | 23 | 32 | 107 | 549 | 141 |
| 7 | 18 | 4 | 283 | 185 | 943 | 257 | 27 | 6 | 36 | 71 | 140 | 401 | 71 | 168 | 95 | 1030 | 170 | 25 | 7 | 19 | 21 | 82 | 547 | 95 |
| 7 | 18 | 4 | 226 | 113 | 1019 | 181 | 29 | 6 | 30 | 69 | 95 | 461 | 75 | 105 | 98 | 1006 | 194 | 18 | 6 | 22 | 23 | 83 | 399 | 91 |
| 7 | 19 | 4 | 345 | 343 | 628 | 572 | 18 | 19 | 96 | 202 | 237 | 162 | 203 | 336 | 322 | 656 | 544 | 18 | 18 | 91 | 199 | 236 | 187 | 178 |
| 7 | 19 | 4 | 320 | 297 | 564 | 636 | 15 | 15 | 90 | 213 | 195 | 163 | 193 | 255 | 300 | 515 | 685 | 17 | 16 | 76 | 187 | 166 | 215 | 210 |
| 7 | 19 | 4 | 295 | 320 | 557 | 643 | 16 | 18 | 77 | 185 | 196 | 228 | 210 | 268 | 254 | 652 | 548 | 18 | 16 | 80 | 178 | 174 | 297 | 223 |
| 7 | 19 | 4 | 229 | 177 | 571 | 629 | 15 | 15 | 73 | 158 | 111 | 248 | 246 | 233 | 181 | 527 | 673 | 16 | 16 | 55 | 171 | 101 | 289 | 296 |
| 7 | 19 | 4 | 286 | 236 | 537 | 663 | 17 | 15 | 73 | 184 | 148 | 181 | 216 | 206 | 203 | 536 | 664 | 16 | 16 | 60 | 150 | 106 | 289 | 290 |
| 7 | 20 | 6 | 201 | 281 | 498 | 702 | 15 | 15 | 56 | 135 | 156 | 126 | 156 | 187 | 306 | 490 | 710 | 16 | 16 | 52 | 123 | 113 | 197 | 185 |
| 7 | 20 | 6 | 183 | 346 | 372 | 828 | 15 | 15 | 44 | 133 | 73 | 141 | 185 | 226 | 281 | 500 | 700 | 15 | 15 | 54 | 168 | 114 | 210 | 231 |
| 7 | 20 | 6 | 246 | 298 | 490 | 710 | 16 | 16 | 56 | 174 | 111 | 150 | 169 | 225 | 264 | 551 | 649 | 15 | 15 | 71 | 153 | 129 | 200 | 204 |
| 7 | 20 | 6 | 178 | 244 | 500 | 700 | 15 | 15 | 56 | 104 | 92 | 169 | 182 | 140 | 236 | 527 | 673 | 14 | 14 | 46 | 78 | 79 | 247 | 243 |
| 7 | 20 | 6 | 194 | 266 | 498 | 702 | 15 | 15 | 57 | 120 | 85 | 159 | 190 | 131 | 233 | 543 | 657 | 15 | 15 | 50 | 82 | 78 | 251 | 219 |
| 7 | 21 | 6 | 38 | 237 | 100 | 1100 | 3 | 29 | 10 | 25 | 14 | 44 | 386 | 26 | 170 | 77 | 1123 | 2 | 32 | 10 | 19 | 13 | 27 | 497 |
| 7 | 21 | 6 | 13 | 202 | 74 | 1126 | 2 | 21 | 8 | 11 | 11 | 32 | 331 | 0 | 12 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 21 | 6 | 23 | 172 | 92 | 1108 | 4 | 28 | 7 | 19 | 4 | 54 | 454 | 29 | 115 | 113 | 1087 | 4 | 25 | 8 | 25 | 7 | 75 | 458 |
| 7 | 21 | 6 | 46 | 180 | 110 | 1090 | 3 | 26 | 12 | 30 | 22 | 44 | 505 | 48 | 96 | 144 | 1056 | 2 | 23 | 14 | 25 | 19 | 47 | 630 |
| 7 | 21 | 6 | 6 | 142 | 52 | 1148 | 1 | 27 | 6 | 5 | 6 | 18 | 425 | 0 | 13 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 22 | 6 | 268 | 59 | 1100 | 100 | 31 | 2 | 14 | 20 | 51 | 394 | 21 | 169 | 62 | 1093 | 107 | 31 | 3 | 14 | 14 | 54 | 465 | 39 |
| 7 | 22 | 6 | 266 | 66 | 1101 | 99 | 31 | 5 | 13 | 11 | 61 | 348 | 47 | 210 | 75 | 1056 | 144 | 30 | 4 | 17 | 25 | 64 | 449 | 63 |
| 7 | 22 | 6 | 231 | 77 | 1044 | 130 | 33 | 4 | 17 | 29 | 63 | 410 | 49 | 187 | 75 | 1110 | 90 | 32 | 2 | 12 | 26 | 57 | 588 | 26 |
| 7 | 22 | 6 | 246 | 83 | 1072 | 128 | 30 | 3 | 20 | 37 | 69 | 411 | 32 | 206 | 37 | 1141 | 59 | 35 | 3 | 6 | 6 | 34 | 515 | 31 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 22 | 6 | 276 | 32 | 1126 | 74 | 31 | 2 | 14 | 21 | 30 | 365 | 19 | 188 | 78 | 1054 | 146 | 28 | 5 | 14 | 14 | 69 | 469 | 81 |
| 7 | 23 | 6 | 79 | 320 | 156 | 1044 | 7 | 26 | 14 | 71 | 28 | 85 | 351 | 115 | 276 | 180 | 1020 | 6 | 24 | 20 | 89 | 31 | 69 | 419 |
| 7 | 23 | 6 | 57 | 298 | 127 | 1073 | 5 | 29 | 12 | 51 | 26 | 67 | 395 | 95 | 271 | 188 | 1012 | 8 | 24 | 18 | 87 | 25 | 112 | 435 |
| 7 | 23 | 6 | 89 | 292 | 143 | 1057 | 6 | 27 | 14 | 72 | 15 | 73 | 353 | 108 | 276 | 158 | 1042 | 6 | 26 | 16 | 94 | 17 | 76 | 382 |
| 7 | 23 | 6 | 117 | 317 | 205 | 995 | 7 | 21 | 17 | 82 | 26 | 105 | 323 | 74 | 228 | 138 | 1062 | 5 | 30 | 13 | 59 | 22 | 76 | 546 |
| 7 | 23 | 6 | 102 | 343 | 161 | 1039 | 7 | 28 | 16 | 85 | 27 | 82 | 314 | 75 | 260 | 190 | 1010 | 7 | 26 | 16 | 68 | 28 | 119 | 468 |
| 7 | 24 | 6 | 211 | 113 | 990 | 210 | 23 | 5 | 24 | 33 | 87 | 278 | 61 | 229 | 150 | 977 | 223 | 26 | 6 | 31 | 54 | 119 | 355 | 85 |
| 7 | 24 | 6 | 268 | 91 | 1040 | 160 | 27 | 5 | 23 | 38 | 78 | 295 | 57 | 225 | 110 | 1000 | 200 | 21 | 6 | 26 | 42 | 92 | 240 | 82 |
| 7 | 24 | 6 | 248 | 145 | 904 | 296 | 22 | 5 | 25 | 39 | 108 | 267 | 57 | 211 | 91 | 1042 | 158 | 26 | 7 | 16 | 18 | 84 | 390 | 79 |
| 7 | 24 | 6 | 203 | 69 | 1066 | 134 | 24 | 4 | 14 | 25 | 60 | 323 | 60 | 175 | 130 | 952 | 248 | 17 | 6 | 24 | 40 | 103 | 230 | 127 |
| 7 | 24 | 6 | 281 | 153 | 987 | 213 | 25 | 7 | 28 | 52 | 124 | 353 | 63 | 189 | 75 | 1083 | 117 | 28 | 6 | 12 | 8 | 69 | 555 | 63 |
| 7 | 25 | 6 | 141 | 130 | 475 | 725 | 12 | 13 | 30 | 86 | 40 | 192 | 266 | 135 | 124 | 573 | 627 | 14 | 11 | 37 | 91 | 56 | 313 | 236 |
| 7 | 25 | 6 | 146 | 171 | 415 | 785 | 13 | 14 | 35 | 108 | 48 | 176 | 380 | 130 | 118 | 476 | 724 | 12 | 11 | 36 | 89 | 49 | 224 | 272 |
| 7 | 25 | 6 | 104 | 126 | 382 | 818 | 11 | 11 | 30 | 82 | 40 | 162 | 224 | 62 | 69 | 296 | 904 | 6 | 7 | 24 | 51 | 26 | 128 | 202 |
| 7 | 25 | 6 | 179 | 188 | 432 | 768 | 14 | 14 | 35 | 122 | 47 | 160 | 238 | 150 | 128 | 516 | 684 | 11 | 12 | 39 | 108 | 49 | 254 | 312 |
| 7 | 25 | 6 | 161 | 188 | 506 | 694 | 13 | 13 | 40 | 114 | 73 | 211 | 288 | 177 | 183 | 514 | 686 | 13 | 12 | 48 | 131 | 73 | 219 | 294 |
| 8 | 1 | 0 | 218 | 365 | 454 | 746 | 21 | 23 | 178 | 89 | 89 | 278 | 327 | 109 | 197 | 437 | 763 | 17 | 16 | 100 | 50 | 50 | 277 | 287 |
| 8 | 1 | 0 | 262 | 413 | 519 | 681 | 22 | 23 | 201 | 101 | 100 | 312 | 295 | 136 | 228 | 669 | 531 | 18 | 16 | 112 | 56 | 56 | 504 | 236 |
| 8 | 1 | 0 | 249 | 384 | 517 | 683 | 23 | 22 | 194 | 97 | 97 | 347 | 312 | 186 | 307 | 479 | 721 | 19 | 19 | 168 | 97 | 112 | 285 | 289 |
| 8 | 1 | 0 | 203 | 367 | 489 | 711 | 23 | 22 | 183 | 92 | 91 | 341 | 295 | 138 | 239 | 434 | 766 | 18 | 18 | 119 | 59 | 60 | 323 | 299 |
| 8 | 1 | 0 | 189 | 289 | 499 | 701 | 20 | 20 | 158 | 79 | 79 | 337 | 306 | 71 | 124 | 545 | 655 | 10 | 10 | 63 | 32 | 31 | 193 | 164 |
| 8 | 2 | 0 | 167 | 612 | 108 | 1092 | 4 | 43 | 158 | 79 | 79 | 58 | 463 | 124 | 463 | 95 | 1105 | 5 | 40 | 112 | 56 | 56 | 48 | 473 |
| 8 | 2 | 0 | 193 | 536 | 215 | 985 | 3 | 35 | 154 | 77 | 77 | 21 | 311 | 11 | 18 | 576 | 624 | 0 | 3 | 9 | 5 | 4 | 0 | 599 |
| 8 | 2 | 0 | 152 | 516 | 116 | 1084 | 4 | 27 | 130 | 65 | 65 | 10 | 246 | 2 | 5 | 501 | 699 | 0 | 1 | 4 | 2 | 2 | 0 | 132 |
| 8 | 2 | 0 | 181 | 751 | 77 | 1123 | 4 | 44 | 170 | 85 | 85 | 33 | 525 | 132 | 567 | 132 | 1068 | 7 | 41 | 123 | 62 | 61 | 93 | 508 |
| 8 | 2 | 0 | 190 | 764 | 109 | 1091 | 7 | 42 | 164 | 82 | 82 | 53 | 452 | 18 | 43 | 529 | 671 | 0 | 5 | 16 | 8 | 8 | 0 | 42 |
| 8 | 3 | 0 | 236 | 61 | 965 | 235 | 21 | 3 | 55 | 27 | 28 | 91 | 9 | 134 | 25 | 974 | 226 | 17 | 1 | 25 | 13 | 12 | 197 | 1 |
| 8 | 3 | 0 | 385 | 112 | 911 | 289 | 26 | 3 | 88 | 44 | 44 | 158 | 18 | 41 | 31 | 853 | 347 | 10 | 2 | 13 | 6 | 7 | 111 | 50 |
| 8 | 3 | 0 | 366 | 120 | 883 | 317 | 28 | 4 | 94 | 47 | 47 | 321 | 39 | 524 | 141 | 1108 | 92 | 39 | 3 | 108 | 54 | 54 | 376 | 33 |
| 8 | 3 | 0 | 642 | 145 | 1072 | 128 | 37 | 3 | 144 | 72 | 72 | 187 | 22 | 366 | 85 | 1052 | 148 | 30 | 5 | 86 | 43 | 43 | 376 | 60 |
| 8 | 3 | 0 | 682 | 216 | 1013 | 187 | 41 | 6 | 184 | 92 | 92 | 539 | 75 | 484 | 175 | 1015 | 185 | 40 | 5 | 162 | 81 | 81 | 583 | 90 |
| 8 | 4 | 0 | 196 | 655 | 204 | 996 | 8 | 37 | 182 | 91 | 91 | 119 | 514 | 133 | 397 | 211 | 989 | 8 | 36 | 118 | 59 | 59 | 134 | 609 |
| 8 | 4 | 0 | 158 | 464 | 227 | 973 | 8 | 34 | 130 | 65 | 65 | 146 | 609 | 71 | 205 | 202 | 998 | 7 | 31 | 58 | 29 | 29 | 152 | 728 |
| 8 | 4 | 0 | 157 | 380 | 277 | 923 | 10 | 33 | 124 | 62 | 62 | 187 | 588 | 77 | 263 | 180 | 1020 | 7 | 30 | 58 | 29 | 29 | 135 | 664 |
| 8 | 4 | 0 | 175 | 418 | 219 | 981 | 8 | 33 | 118 | 59 | 59 | 143 | 589 | 83 | 225 | 250 | 950 | 8 | 30 | 62 | 31 | 31 | 179 | 600 |
| 8 | 4 | 0 | 146 | 316 | 218 | 982 | 7 | 31 | 101 | 51 | 50 | 114 | 644 | 30 | 62 | 167 | 1033 | 5 | 16 | 27 | 13 | 14 | 132 | 806 |
| 8 | 5 | 0 | 205 | 179 | 509 | 691 | 21 | 6 | 105 | 52 | 53 | 353 | 115 | 33 | 11 | 1029 | 171 | 8 | 3 | 13 | 7 | 6 | 427 | 101 |
| 8 | 5 | 0 | 236 | 178 | 958 | 242 | 19 | 3 | 120 | 60 | 60 | 293 | 53 | 34 | 16 | 912 | 288 | 8 | 3 | 16 | 8 | 8 | 827 | 45 |
| 8 | 5 | 0 | 268 | 204 | 439 | 761 | 20 | 4 | 129 | 64 | 65 | 265 | 54 | 124 | 75 | 665 | 535 | 15 | 3 | 61 | 31 | 30 | 224 | 46 |
| 8 | 5 | 0 | 128 | 80 | 814 | 386 | 18 | 2 | 64 | 32 | 32 | 642 | 31 | 22 | 13 | 735 | 465 | 4 | 2 | 11 | 5 | 6 | 318 | 21 |
| 8 | 5 | 0 | 206 | 150 | 674 | 526 | 29 | 8 | 100 | 50 | 50 | 425 | 125 | 31 | 15 | 820 | 380 | 8 | 1 | 10 | 5 | 5 | 332 | 24 |

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| 8 | 6 | 0 | 73 | 97 | 836 | 364 | 10 | 12 | 57 | 29 | 28 | 161 | 161 | 18 | 21 | 1150 | 50 | 2 | 2 | 16 | 8 | 8 | 27 | 21 |
| 8 | 6 | 0 | 183 | 228 | 491 | 709 | 17 | 18 | 126 | 63 | 63 | 324 | 433 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 |
| 8 | 6 | 0 | 201 | 250 | 495 | 705 | 19 | 20 | 134 | 67 | 67 | 374 | 334 | 66 | 77 | 391 | 809 | 11 | 10 | 52 | 26 | 26 | 330 | 190 |
| 8 | 6 | 0 | 217 | 269 | 513 | 687 | 20 | 22 | 153 | 76 | 77 | 383 | 385 | 105 | 130 | 267 | 933 | 11 | 11 | 80 | 40 | 40 | 198 | 521 |
| 8 | 6 | 0 | 302 | 350 | 478 | 722 | 21 | 21 | 192 | 96 | 96 | 330 | 324 | 132 | 160 | 546 | 654 | 16 | 17 | 96 | 48 | 48 | 336 | 317 |
| 8 | 7 | 2 | 263 | 358 | 471 | 729 | 16 | 16 | 62 | 164 | 148 | 279 | 279 | 123 | 188 | 292 | 908 | 8 | 9 | 32 | 81 | 73 | 138 | 212 |
| 8 | 7 | 2 | 337 | 507 | 554 | 646 | 18 | 19 | 74 | 197 | 213 | 332 | 327 | 174 | 217 | 402 | 798 | 14 | 14 | 47 | 123 | 95 | 269 | 267 |
| 8 | 7 | 2 | 381 | 445 | 584 | 616 | 17 | 17 | 74 | 218 | 218 | 318 | 313 | 113 | 115 | 259 | 941 | 7 | 7 | 28 | 69 | 59 | 138 | 154 |
| 8 | 7 | 2 | 333 | 414 | 501 | 699 | 18 | 17 | 66 | 183 | 199 | 278 | 253 | 164 | 224 | 458 | 742 | 12 | 13 | 38 | 93 | 116 | 229 | 254 |
| 8 | 7 | 2 | 329 | 496 | 469 | 731 | 18 | 18 | 72 | 205 | 225 | 272 | 326 | 157 | 227 | 612 | 588 | 11 | 12 | 43 | 115 | 105 | 213 | 229 |
| 8 | 8 | 2 | 212 | 494 | 182 | 1018 | 4 | 33 | 50 | 143 | 164 | 72 | 439 | 107 | 250 | 291 | 909 | 3 | 26 | 30 | 85 | 85 | 45 | 456 |
| 8 | 8 | 2 | 128 | 403 | 148 | 1052 | 5 | 35 | 32 | 97 | 98 | 86 | 522 | 99 | 354 | 98 | 1102 | 3 | 35 | 22 | 69 | 68 | 45 | 637 |
| 8 | 8 | 2 | 151 | 394 | 146 | 1054 | 4 | 35 | 34 | 101 | 101 | 64 | 584 | 53 | 225 | 115 | 1085 | 4 | 32 | 16 | 40 | 26 | 76 | 641 |
| 8 | 8 | 2 | 237 | 526 | 212 | 988 | 6 | 32 | 44 | 148 | 125 | 96 | 539 | 110 | 256 | 131 | 1069 | 4 | 33 | 28 | 72 | 70 | 79 | 631 |
| 8 | 8 | 2 | 149 | 323 | 125 | 1075 | 3 | 35 | 30 | 98 | 86 | 55 | 611 | 63 | 233 | 124 | 1076 | 4 | 31 | 16 | 49 | 36 | 82 | 574 |
| 8 | 9 | 2 | 648 | 173 | 1052 | 148 | 35 | 4 | 50 | 167 | 134 | 637 | 67 | 316 | 79 | 1106 | 94 | 32 | 3 | 30 | 88 | 60 | 749 | 59 |
| 8 | 9 | 2 | 460 | 162 | 1078 | 122 | 35 | 4 | 42 | 115 | 121 | 651 | 61 | 319 | 119 | 1102 | 98 | 33 | 2 | 40 | 126 | 88 | 687 | 42 |
| 8 | 9 | 2 | 607 | 123 | 1006 | 194 | 32 | 5 | 44 | 133 | 100 | 562 | 85 | 409 | 221 | 1030 | 170 | 34 | 4 | 50 | 157 | 142 | 635 | 59 |
| 8 | 9 | 2 | 475 | 224 | 1089 | 111 | 36 | 2 | 62 | 208 | 165 | 677 | 33 | 274 | 125 | 1042 | 158 | 29 | 5 | 46 | 131 | 103 | 642 | 79 |
| 8 | 9 | 2 | 442 | 174 | 1054 | 146 | 34 | 4 | 46 | 141 | 135 | 632 | 72 | 262 | 105 | 1093 | 107 | 32 | 4 | 34 | 101 | 83 | 717 | 68 |
| 8 | 10 | 2 | 298 | 629 | 269 | 931 | 7 | 33 | 73 | 207 | 226 | 118 | 501 | 158 | 356 | 230 | 970 | 8 | 30 | 40 | 116 | 109 | 143 | 613 |
| 8 | 10 | 2 | 316 | 516 | 329 | 871 | 9 | 32 | 58 | 204 | 179 | 170 | 512 | 193 | 377 | 245 | 955 | 7 | 30 | 38 | 134 | 111 | 157 | 634 |
| 8 | 10 | 2 | 290 | 537 | 275 | 925 | 7 | 32 | 57 | 187 | 168 | 134 | 565 | 183 | 351 | 276 | 924 | 8 | 28 | 38 | 133 | 100 | 180 | 613 |
| 8 | 10 | 2 | 310 | 605 | 259 | 941 | 7 | 32 | 65 | 209 | 208 | 112 | 546 | 101 | 288 | 201 | 999 | 7 | 26 | 27 | 80 | 66 | 140 | 601 |
| 8 | 10 | 2 | 235 | 546 | 277 | 923 | 8 | 32 | 48 | 168 | 144 | 165 | 561 | 146 | 299 | 200 | 1000 | 6 | 26 | 34 | 106 | 98 | 124 | 638 |
| 8 | 11 | 2 | 249 | 193 | 905 | 295 | 26 | 8 | 40 | 103 | 126 | 636 | 199 | 204 | 185 | 929 | 271 | 27 | 6 | 39 | 93 | 107 | 662 | 145 |
| 8 | 11 | 2 | 301 | 259 | 906 | 294 | 28 | 8 | 48 | 119 | 154 | 592 | 168 | 269 | 273 | 956 | 244 | 28 | 5 | 47 | 129 | 154 | 678 | 90 |
| 8 | 11 | 2 | 346 | 225 | 908 | 292 | 27 | 9 | 48 | 135 | 150 | 585 | 183 | 149 | 115 | 954 | 246 | 26 | 5 | 30 | 64 | 71 | 708 | 112 |
| 8 | 11 | 2 | 317 | 241 | 949 | 251 | 32 | 6 | 48 | 129 | 145 | 610 | 122 | 218 | 168 | 948 | 252 | 26 | 8 | 36 | 82 | 110 | 644 | 169 |
| 8 | 11 | 2 | 354 | 211 | 941 | 259 | 28 | 9 | 48 | 104 | 149 | 547 | 152 | 328 | 221 | 986 | 214 | 28 | 5 | 46 | 126 | 131 | 635 | 114 |
| 8 | 12 | 2 | 4 | 206 | 3 | 1197 | 0 | 33 | 4 | 4 | 7 | 0 | 577 | 0 | 20 | 0 | 1200 | 0 | 10 | 0 | 0 | 0 | 0 | 501 |
| 8 | 12 | 2 | 1 | 197 | 1 | 1199 | 0 | 39 | 2 | 1 | 6 | 0 | 744 | 3 | 47 | 9 | 1191 | 0 | 12 | 6 | 3 | 9 | 0 | 221 |
| 8 | 12 | 2 | 2 | 171 | 3 | 1197 | 0 | 27 | 4 | 2 | 8 | 0 | 442 | 0 | 14 | 0 | 1200 | 0 | 5 | 0 | 0 | 0 | 0 | 1056 |
| 8 | 12 | 2 | 5 | 144 | 6 | 1194 | 0 | 31 | 2 | 3 | 3 | 0 | 742 | 0 | 85 | 0 | 1200 | 0 | 14 | 0 | 0 | 0 | 0 | 308 |
| 8 | 12 | 2 | 5 | 288 | 11 | 1189 | 0 | 38 | 5 | 4 | 12 | 0 | 641 | 0 | 64 | 0 | 1200 | 0 | 11 | 0 | 0 | 0 | 0 | 144 |
| 8 | 13 | 2 | 464 | 374 | 695 | 505 | 18 | 18 | 88 | 207 | 220 | 261 | 257 | 301 | 319 | 672 | 528 | 15 | 15 | 69 | 164 | 190 | 306 | 249 |
| 8 | 13 | 2 | 389 | 386 | 538 | 662 | 17 | 16 | 75 | 201 | 208 | 283 | 316 | 270 | 301 | 538 | 662 | 14 | 15 | 66 | 172 | 168 | 269 | 293 |
| 8 | 13 | 2 | 256 | 211 | 815 | 385 | 11 | 11 | 60 | 143 | 141 | 196 | 194 | 76 | 78 | 995 | 205 | 5 | 4 | 23 | 52 | 43 | 117 | 60 |
| 8 | 13 | 2 | 198 | 170 | 614 | 586 | 12 | 14 | 52 | 124 | 115 | 274 | 350 | 64 | 63 | 770 | 430 | 7 | 6 | 17 | 46 | 33 | 158 | 121 |
| 8 | 13 | 2 | 144 | 185 | 699 | 501 | 9 | 10 | 44 | 99 | 89 | 257 | 225 | 85 | 104 | 694 | 506 | 6 | 5 | 21 | 54 | 52 | 136 | 90 |

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| 8 | 14 | 4 | 506 | 555 | 604 | 596 | 19 | 18 | 67 | 282 | 332 | 310 | 238 | 440 | 381 | 528 | 672 | 16 | 16 | 51 | 277 | 189 | 275 | 273 |
| 8 | 14 | 4 | 429 | 418 | 590 | 610 | 17 | 18 | 62 | 272 | 276 | 335 | 318 | 477 | 480 | 560 | 640 | 18 | 17 | 67 | 337 | 304 | 292 | 304 |
| 8 | 14 | 4 | 621 | 591 | 573 | 627 | 19 | 19 | 72 | 376 | 328 | 241 | 277 | 409 | 451 | 491 | 709 | 16 | 17 | 57 | 278 | 277 | 245 | 329 |
| 8 | 14 | 4 | 504 | 546 | 534 | 666 | 17 | 17 | 66 | 331 | 312 | 257 | 297 | 352 | 345 | 536 | 664 | 15 | 15 | 48 | 223 | 214 | 290 | 342 |
| 8 | 14 | 4 | 454 | 524 | 542 | 658 | 19 | 18 | 66 | 297 | 287 | 268 | 269 | 361 | 415 | 527 | 673 | 16 | 16 | 52 | 235 | 244 | 296 | 323 |
| 8 | 15 | 4 | 190 | 662 | 138 | 1062 | 4 | 33 | 36 | 150 | 187 | 50 | 471 | 100 | 385 | 86 | 1114 | 3 | 36 | 14 | 79 | 73 | 43 | 593 |
| 8 | 15 | 4 | 308 | 810 | 178 | 1022 | 5 | 35 | 46 | 229 | 230 | 52 | 401 | 191 | 538 | 117 | 1083 | 4 | 36 | 25 | 141 | 141 | 37 | 545 |
| 8 | 15 | 4 | 212 | 933 | 180 | 1020 | 5 | 35 | 32 | 164 | 178 | 85 | 434 | 88 | 475 | 115 | 1085 | 5 | 36 | 16 | 78 | 75 | 69 | 627 |
| 8 | 15 | 4 | 166 | 759 | 105 | 1095 | 3 | 39 | 40 | 136 | 203 | 25 | 465 | 141 | 428 | 128 | 1072 | 5 | 32 | 24 | 121 | 112 | 61 | 467 |
| 8 | 15 | 4 | 287 | 920 | 202 | 998 | 6 | 34 | 44 | 223 | 236 | 72 | 408 | 218 | 579 | 125 | 1075 | 4 | 34 | 26 | 167 | 138 | 41 | 448 |
| 8 | 16 | 4 | 1005 | 333 | 960 | 240 | 35 | 4 | 61 | 314 | 210 | 267 | 35 | 652 | 207 | 1027 | 173 | 36 | 6 | 36 | 182 | 135 | 461 | 52 |
| 8 | 16 | 4 | 949 | 196 | 1021 | 179 | 38 | 5 | 50 | 240 | 153 | 375 | 30 | 1190 | 268 | 966 | 234 | 33 | 5 | 62 | 353 | 193 | 193 | 44 |
| 8 | 16 | 4 | 1421 | 144 | 1070 | 130 | 27 | 2 | 47 | 268 | 103 | 174 | 10 | 864 | 203 | 975 | 225 | 36 | 4 | 43 | 242 | 139 | 408 | 42 |
| 8 | 16 | 4 | 1264 | 165 | 1073 | 127 | 34 | 4 | 50 | 277 | 139 | 364 | 25 | 806 | 145 | 1004 | 196 | 34 | 5 | 42 | 227 | 103 | 478 | 32 |
| 8 | 16 | 4 | 1125 | 169 | 1020 | 180 | 32 | 5 | 45 | 257 | 125 | 400 | 63 | 589 | 151 | 1008 | 192 | 33 | 4 | 32 | 185 | 121 | 548 | 58 |
| 8 | 17 | 4 | 334 | 748 | 256 | 944 | 7 | 32 | 51 | 228 | 262 | 79 | 402 | 280 | 781 | 231 | 969 | 8 | 29 | 46 | 196 | 265 | 82 | 345 |
| 8 | 17 | 4 | 374 | 775 | 289 | 911 | 7 | 34 | 60 | 248 | 311 | 68 | 308 | 223 | 508 | 227 | 973 | 9 | 29 | 30 | 145 | 144 | 112 | 370 |
| 8 | 17 | 4 | 385 | 887 | 282 | 918 | 10 | 32 | 60 | 294 | 325 | 90 | 341 | 255 | 595 | 218 | 982 | 7 | 30 | 32 | 189 | 186 | 107 | 503 |
| 8 | 17 | 4 | 262 | 782 | 223 | 977 | 8 | 33 | 42 | 191 | 223 | 93 | 421 | 218 | 492 | 201 | 999 | 7 | 31 | 28 | 155 | 164 | 98 | 507 |
| 8 | 17 | 4 | 327 | 883 | 247 | 953 | 8 | 30 | 46 | 237 | 260 | 81 | 366 | 225 | 607 | 199 | 1001 | 7 | 31 | 34 | 164 | 199 | 86 | 443 |
| 8 | 18 | 4 | 980 | 490 | 808 | 392 | 32 | 10 | 57 | 288 | 282 | 240 | 101 | 992 | 396 | 884 | 316 | 31 | 7 | 51 | 239 | 240 | 246 | 61 |
| 8 | 18 | 4 | 1025 | 463 | 847 | 353 | 32 | 9 | 57 | 261 | 256 | 199 | 64 | 1083 | 532 | 862 | 338 | 33 | 6 | 57 | 270 | 315 | 240 | 42 |
| 8 | 18 | 4 | 960 | 471 | 875 | 325 | 35 | 7 | 65 | 283 | 283 | 241 | 63 | 872 | 450 | 865 | 335 | 31 | 8 | 56 | 255 | 254 | 287 | 73 |
| 8 | 18 | 4 | 897 | 520 | 793 | 407 | 28 | 9 | 62 | 295 | 266 | 184 | 76 | 945 | 485 | 878 | 322 | 31 | 6 | 55 | 295 | 263 | 268 | 48 |
| 8 | 18 | 4 | 720 | 447 | 901 | 298 | 32 | 6 | 60 | 267 | 274 | 335 | 62 | 895 | 336 | 907 | 293 | 33 | 10 | 55 | 265 | 229 | 263 | 89 |
| 8 | 19 | 4 | 512 | 778 | 489 | 711 | 19 | 19 | 71 | 272 | 361 | 129 | 129 | 581 | 737 | 533 | 667 | 19 | 18 | 76 | 347 | 391 | 168 | 167 |
| 8 | 19 | 4 | 570 | 729 | 513 | 687 | 17 | 18 | 76 | 325 | 348 | 137 | 154 | 456 | 607 | 510 | 690 | 17 | 18 | 59 | 286 | 316 | 220 | 269 |
| 8 | 19 | 4 | 429 | 508 | 560 | 640 | 18 | 19 | 59 | 246 | 273 | 279 | 269 | 498 | 476 | 551 | 649 | 18 | 18 | 53 | 239 | 240 | 207 | 210 |
| 8 | 19 | 4 | 592 | 642 | 600 | 600 | 18 | 21 | 74 | 259 | 342 | 160 | 146 | 538 | 490 | 565 | 635 | 19 | 18 | 53 | 232 | 253 | 157 | 151 |
| 8 | 19 | 4 | 801 | 652 | 607 | 593 | 20 | 19 | 76 | 347 | 352 | 98 | 99 | 520 | 706 | 557 | 643 | 19 | 17 | 57 | 231 | 300 | 141 | 154 |
| 8 | 20 | 6 | 538 | 421 | 602 | 598 | 16 | 18 | 40 | 263 | 262 | 242 | 267 | 268 | 305 | 531 | 669 | 14 | 11 | 29 | 164 | 174 | 287 | 257 |
| 8 | 20 | 6 | 408 | 345 | 587 | 613 | 14 | 15 | 34 | 224 | 215 | 305 | 331 | 291 | 238 | 598 | 602 | 14 | 11 | 27 | 167 | 142 | 338 | 262 |
| 8 | 20 | 6 | 393 | 385 | 573 | 627 | 14 | 14 | 41 | 239 | 242 | 296 | 294 | 276 | 295 | 559 | 641 | 12 | 14 | 35 | 139 | 199 | 294 | 276 |
| 8 | 20 | 6 | 536 | 445 | 649 | 551 | 13 | 12 | 39 | 261 | 254 | 274 | 224 | 384 | 435 | 566 | 634 | 12 | 12 | 36 | 230 | 246 | 302 | 326 |
| 8 | 20 | 6 | 416 | 429 | 577 | 623 | 14 | 13 | 37 | 257 | 239 | 291 | 257 | 277 | 291 | 500 | 700 | 8 | 11 | 25 | 149 | 169 | 221 | 306 |
| 8 | 21 | 6 | 130 | 572 | 200 | 1000 | 5 | 28 | 20 | 82 | 114 | 52 | 339 | 96 | 441 | 114 | 1086 | 2 | 25 | 10 | 59 | 68 | 28 | 255 |
| 8 | 21 | 6 | 215 | 729 | 260 | 940 | 4 | 29 | 27 | 105 | 173 | 27 | 212 | 79 | 675 | 82 | 1118 | 3 | 34 | 10 | 58 | 67 | 21 | 368 |
| 8 | 21 | 6 | 163 | 520 | 211 | 989 | 4 | 29 | 23 | 114 | 124 | 47 | 267 | 215 | 596 | 254 | 946 | 4 | 25 | 23 | 130 | 163 | 31 | 227 |
| 8 | 21 | 6 | 163 | 668 | 160 | 1040 | 3 | 27 | 17 | 89 | 103 | 7 | 193 | 189 | 524 | 219 | 981 | 3 | 30 | 19 | 70 | 132 | 27 | 282 |
| 8 | 21 | 6 | 92 | 661 | 170 | 1030 | 4 | 26 | 20 | 70 | 124 | 23 | 183 | 178 | 519 | 289 | 911 | 3 | 26 | 19 | 77 | 136 | 68 | 213 |
| 8 | 22 | 6 | 430 | 80 | 1025 | 175 | 28 | 4 | 14 | 93 | 55 | 460 | 46 | 339 | 57 | 1014 | 186 | 26 | 3 | 12 | 59 | 40 | 499 | 43 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 22 | 6 | 457 | 141 | 1024 | 176 | 30 | 2 | 18 | 128 | 75 | 431 | 25 | 407 | 93 | 1018 | 182 | 29 | 4 | 18 | 114 | 62 | 476 | 58 |
| 8 | 22 | 6 | 526 | 121 | 971 | 229 | 29 | 4 | 27 | 178 | 85 | 390 | 68 | 401 | 104 | 1008 | 192 | 30 | 3 | 15 | 107 | 66 | 469 | 50 |
| 8 | 22 | 6 | 630 | 217 | 966 | 234 | 31 | 4 | 23 | 174 | 126 | 449 | 41 | 467 | 126 | 1019 | 181 | 29 | 4 | 18 | 125 | 81 | 428 | 56 |
| 8 | 22 | 6 | 559 | 91 | 981 | 219 | 27 | 4 | 19 | 137 | 58 | 337 | 55 | 410 | 60 | 1071 | 129 | 29 | 3 | 8 | 45 | 37 | 401 | 37 |
| 8 | 23 | 6 | 259 | 432 | 437 | 763 | 4 | 25 | 39 | 103 | 237 | 34 | 142 | 173 | 462 | 304 | 896 | 7 | 26 | 25 | 88 | 168 | 56 | 217 |
| 8 | 23 | 6 | 176 | 448 | 274 | 926 | 4 | 28 | 31 | 98 | 159 | 22 | 207 | 155 | 615 | 228 | 972 | 8 | 24 | 20 | 105 | 137 | 78 | 374 |
| 8 | 23 | 6 | 106 | 527 | 248 | 952 | 6 | 24 | 23 | 55 | 141 | 42 | 297 | 137 | 499 | 267 | 933 | 6 | 24 | 22 | 66 | 137 | 80 | 314 |
| 8 | 23 | 6 | 308 | 671 | 372 | 828 | 7 | 29 | 41 | 173 | 299 | 67 | 206 | 244 | 602 | 338 | 862 | 7 | 28 | 31 | 138 | 267 | 53 | 267 |
| 8 | 23 | 6 | 268 | 664 | 326 | 874 | 8 | 28 | 40 | 169 | 306 | 49 | 253 | 225 | 521 | 267 | 933 | 4 | 20 | 33 | 127 | 247 | 20 | 198 |
| 8 | 24 | 6 | 431 | 144 | 814 | 386 | 22 | 4 | 15 | 94 | 110 | 273 | 46 | 452 | 87 | 1049 | 151 | 22 | 4 | 11 | 67 | 68 | 368 | 55 |
| 8 | 24 | 6 | 522 | 282 | 824 | 376 | 22 | 6 | 29 | 190 | 182 | 326 | 89 | 365 | 231 | 841 | 359 | 25 | 6 | 26 | 153 | 165 | 393 | 95 |
| 8 | 24 | 6 | 366 | 261 | 651 | 549 | 18 | 6 | 30 | 174 | 173 | 228 | 83 | 380 | 127 | 1002 | 198 | 22 | 5 | 17 | 98 | 107 | 338 | 75 |
| 8 | 24 | 6 | 238 | 97 | 584 | 616 | 16 | 2 | 13 | 64 | 63 | 250 | 43 | 338 | 99 | 974 | 226 | 22 | 7 | 18 | 99 | 83 | 335 | 103 |
| 8 | 24 | 6 | 478 | 238 | 865 | 335 | 24 | 7 | 30 | 165 | 171 | 388 | 107 | 390 | 158 | 866 | 334 | 24 | 5 | 22 | 146 | 110 | 443 | 92 |
| 8 | 25 | 6 | 48 | 82 | 146 | 1054 | 3 | 3 | 7 | 17 | 54 | 52 | 42 | 181 | 221 | 634 | 566 | 15 | 14 | 23 | 82 | 145 | 270 | 237 |
| 8 | 25 | 6 | 31 | 105 | 1018 | 182 | 5 | 2 | 9 | 18 | 29 | 86 | 34 | 89 | 166 | 914 | 286 | 3 | 6 | 11 | 45 | 72 | 49 | 107 |
| 8 | 25 | 6 | 233 | 295 | 531 | 669 | 12 | 14 | 27 | 115 | 181 | 198 | 298 | 96 | 99 | 230 | 970 | 4 | 3 | 12 | 35 | 66 | 75 | 54 |
| 8 | 25 | 6 | 235 | 254 | 458 | 742 | 10 | 12 | 21 | 133 | 136 | 154 | 244 | 187 | 202 | 676 | 524 | 12 | 10 | 19 | 111 | 128 | 225 | 238 |
| 8 | 25 | 6 | 243 | 320 | 539 | 661 | 10 | 10 | 24 | 79 | 182 | 171 | 162 | 206 | 296 | 516 | 684 | 10 | 11 | 26 | 87 | 198 | 180 | 209 |
| 9 | 1 | 0 | 200 | 290 | 545 | 655 | 19 | 21 | 158 | 79 | 79 | 362 | 376 | 95 | 131 | 554 | 646 | 14 | 12 | 77 | 39 | 38 | 443 | 504 |
| 9 | 1 | 0 | 195 | 214 | 594 | 606 | 20 | 22 | 133 | 67 | 66 | 379 | 408 | 51 | 95 | 813 | 387 | 9 | 7 | 38 | 19 | 19 | 753 | 295 |
| 9 | 1 | 0 | 249 | 252 | 592 | 608 | 22 | 21 | 149 | 75 | 74 | 365 | 395 | 164 | 54 | 1015 | 185 | 6 | 5 | 48 | 36 | 24 | 300 | 148 |
| 9 | 1 | 0 | 235 | 204 | 662 | 538 | 19 | 18 | 145 | 73 | 72 | 406 | 350 | 90 | 85 | 533 | 667 | 13 | 13 | 66 | 33 | 33 | 354 | 315 |
| 9 | 1 | 0 | 199 | 194 | 604 | 596 | 19 | 19 | 128 | 64 | 64 | 382 | 388 | 96 | 104 | 804 | 396 | 10 | 10 | 60 | 30 | 30 | 608 | 288 |
| 9 | 2 | 0 | 139 | 327 | 171 | 1029 | 5 | 37 | 148 | 74 | 74 | 80 | 639 | 61 | 114 | 119 | 1081 | 4 | 22 | 54 | 27 | 27 | 77 | 905 |
| 9 | 2 | 0 | 116 | 273 | 162 | 1038 | 5 | 36 | 108 | 54 | 54 | 89 | 659 | 10 | 26 | 30 | 1170 | 1 | 8 | 10 | 5 | 5 | 21 | 240 |
| 9 | 2 | 0 | 124 | 333 | 177 | 1023 | 5 | 37 | 114 | 57 | 57 | 106 | 633 | 77 | 169 | 126 | 1074 | 2 | 32 | 69 | 35 | 34 | 79 | 807 |
| 9 | 2 | 0 | 102 | 252 | 170 | 1030 | 5 | 35 | 83 | 41 | 42 | 91 | 683 | 94 | 216 | 142 | 1058 | 4 | 34 | 82 | 41 | 41 | 87 | 736 |
| 9 | 2 | 0 | 110 | 297 | 136 | 1064 | 4 | 36 | 98 | 49 | 49 | 76 | 697 | 46 | 100 | 82 | 1118 | 2 | 25 | 40 | 20 | 20 | 57 | 939 |
| 9 | 3 | 0 | 444 | 165 | 992 | 208 | 39 | 6 | 158 | 79 | 79 | 573 | 100 | 39 | 15 | 1193 | 7 | 8 | 0 | 14 | 7 | 7 | 1141 | 0 |
| 9 | 3 | 0 | 417 | 150 | 1039 | 161 | 39 | 5 | 130 | 65 | 65 | 639 | 66 | 135 | 47 | 465 | 735 | 16 | 2 | 37 | 18 | 19 | 317 | 71 |
| 9 | 3 | 0 | 420 | 149 | 1004 | 196 | 38 | 6 | 111 | 56 | 55 | 623 | 104 | 59 | 27 | 1178 | 22 | 5 | 1 | 20 | 10 | 10 | 117 | 7 |
| 9 | 3 | 0 | 502 | 225 | 965 | 235 | 40 | 6 | 163 | 82 | 81 | 510 | 62 | 13 | 7 | 1197 | 3 | 3 | 0 | 4 | 2 | 2 | 1177 | 0 |
| 9 | 3 | 0 | 160 | 54 | 1109 | 91 | 27 | 4 | 50 | 25 | 25 | 822 | 54 | 87 | 41 | 903 | 297 | 16 | 2 | 33 | 16 | 17 | 575 | 33 |
| 9 | 4 | 0 | 143 | 364 | 188 | 1012 | 7 | 36 | 118 | 59 | 59 | 102 | 576 | 14 | 52 | 1116 | 84 | 1 | 1 | 15 | 8 | 7 | 1105 | 23 |
| 9 | 4 | 0 | 74 | 144 | 604 | 596 | 6 | 14 | 63 | 32 | 31 | 128 | 418 | 4 | 3 | 649 | 551 | 0 | 2 | 1 | 0 | 1 | 0 | 544 |
| 9 | 4 | 0 | 132 | 272 | 120 | 1080 | 4 | 22 | 102 | 51 | 51 | 56 | 782 | 23 | 44 | 86 | 1114 | 2 | 12 | 18 | 9 | 9 | 31 | 967 |
| 9 | 4 | 0 | 134 | 225 | 316 | 884 | 5 | 16 | 128 | 64 | 64 | 42 | 307 | 5 | 7 | 551 | 649 | 1 | 2 | 3 | 2 | 1 | 3 | 514 |
| 9 | 4 | 0 | 145 | 341 | 209 | 991 | 8 | 33 | 130 | 65 | 65 | 125 | 592 | 85 | 189 | 218 | 982 | 7 | 30 | 74 | 37 | 37 | 162 | 714 |
| 9 | 5 | 0 | 342 | 144 | 960 | 240 | 32 | 9 | 116 | 58 | 58 | 622 | 131 | 253 | 119 | 698 | 502 | 20 | 5 | 88 | 44 | 44 | 357 | 51 |
| 9 | 5 | 0 | 529 | 278 | 897 | 303 | 38 | 10 | 187 | 94 | 93 | 482 | 127 | 124 | 70 | 1053 | 147 | 16 | 4 | 50 | 25 | 25 | 836 | 84 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9 | 5 | 0 | 521 | 238 | 889 | 311 | 37 | 10 | 186 | 93 | 93 | 444 | 142 | 299 | 140 | 940 | 260 | 29 | 6 | 108 | 54 | 54 | 646 | 136 |
| 9 | 5 | 0 | 484 | 203 | 958 | 242 | 37 | 8 | 163 | 81 | 82 | 530 | 103 | 201 | 87 | 953 | 247 | 27 | 8 | 75 | 38 | 37 | 577 | 175 |
| 9 | 5 | 0 | 497 | 260 | 935 | 265 | 37 | 9 | 190 | 95 | 95 | 500 | 95 | 401 | 200 | 965 | 235 | 30 | 8 | 154 | 77 | 77 | 616 | 78 |
| 9 | 6 | 0 | 263 | 312 | 560 | 640 | 19 | 19 | 166 | 83 | 83 | 381 | 388 | 157 | 193 | 471 | 729 | 14 | 14 | 110 | 55 | 55 | 339 | 597 |
| 9 | 6 | 0 | 220 | 275 | 511 | 689 | 18 | 18 | 156 | 78 | 78 | 337 | 472 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 |
| 9 | 6 | 0 | 287 | 330 | 630 | 570 | 22 | 20 | 193 | 97 | 96 | 402 | 347 | 208 | 223 | 651 | 549 | 18 | 17 | 132 | 66 | 66 | 461 | 401 |
| 9 | 6 | 0 | 230 | 272 | 609 | 591 | 21 | 21 | 149 | 75 | 74 | 416 | 391 | 191 | 217 | 687 | 513 | 17 | 16 | 116 | 58 | 58 | 482 | 363 |
| 9 | 6 | 0 | 244 | 303 | 563 | 637 | 19 | 19 | 164 | 82 | 82 | 352 | 409 | 177 | 238 | 614 | 586 | 18 | 17 | 120 | 60 | 60 | 438 | 357 |
| 9 | 7 | 2 | 533 | 511 | 588 | 612 | 18 | 20 | 108 | 343 | 305 | 318 | 317 | 272 | 245 | 897 | 303 | 10 | 9 | 53 | 166 | 140 | 755 | 144 |
| 9 | 7 | 2 | 521 | 462 | 563 | 637 | 19 | 19 | 105 | 323 | 262 | 285 | 310 | 421 | 346 | 570 | 630 | 15 | 16 | 79 | 225 | 202 | 220 | 377 |
| 9 | 7 | 2 | 550 | 395 | 643 | 557 | 17 | 17 | 99 | 295 | 263 | 331 | 277 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 |
| 9 | 7 | 2 | 458 | 460 | 579 | 621 | 16 | 16 | 86 | 276 | 237 | 331 | 334 | 84 | 107 | 939 | 261 | 5 | 6 | 27 | 65 | 62 | 887 | 170 |
| 9 | 7 | 2 | 320 | 277 | 658 | 542 | 15 | 14 | 60 | 180 | 159 | 477 | 230 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 | 0 |
| 9 | 8 | 2 | 124 | 321 | 178 | 1022 | 5 | 27 | 30 | 91 | 80 | 118 | 702 | 107 | 176 | 102 | 1098 | 2 | 19 | 22 | 68 | 54 | 52 | 923 |
| 9 | 8 | 2 | 105 | 315 | 141 | 1059 | 4 | 33 | 25 | 77 | 69 | 88 | 752 | 115 | 216 | 88 | 1112 | 1 | 24 | 25 | 76 | 70 | 40 | 910 |
| 9 | 8 | 2 | 68 | 166 | 75 | 1125 | 2 | 23 | 18 | 56 | 42 | 44 | 925 | 100 | 170 | 364 | 836 | 4 | 21 | 26 | 86 | 58 | 317 | 620 |
| 9 | 8 | 2 | 265 | 521 | 168 | 1032 | 3 | 36 | 66 | 195 | 174 | 49 | 575 | 115 | 282 | 101 | 1099 | 3 | 29 | 34 | 92 | 87 | 39 | 624 |
| 9 | 8 | 2 | 132 | 295 | 208 | 992 | 6 | 29 | 42 | 108 | 85 | 135 | 655 | 54 | 84 | 52 | 1148 | 1 | 9 | 14 | 39 | 32 | 29 | 364 |
| 9 | 9 | 2 | 476 | 132 | 1045 | 155 | 33 | 4 | 42 | 135 | 92 | 690 | 77 | 264 | 83 | 1010 | 190 | 28 | 5 | 26 | 91 | 58 | 788 | 137 |
| 9 | 9 | 2 | 377 | 108 | 1039 | 161 | 32 | 4 | 30 | 97 | 78 | 762 | 85 | 342 | 113 | 1074 | 126 | 31 | 2 | 32 | 111 | 71 | 684 | 63 |
| 9 | 9 | 2 | 312 | 68 | 1049 | 151 | 29 | 3 | 24 | 81 | 50 | 815 | 87 | 268 | 69 | 1073 | 127 | 29 | 3 | 20 | 65 | 47 | 851 | 85 |
| 9 | 9 | 2 | 323 | 75 | 1061 | 139 | 28 | 4 | 24 | 79 | 61 | 812 | 86 | 281 | 76 | 1054 | 146 | 28 | 4 | 22 | 67 | 51 | 822 | 86 |
| 9 | 9 | 2 | 374 | 114 | 1022 | 178 | 31 | 5 | 38 | 128 | 89 | 759 | 114 | 230 | 67 | 1062 | 138 | 28 | 3 | 22 | 75 | 50 | 852 | 94 |
| 9 | 10 | 2 | 223 | 241 | 258 | 942 | 6 | 31 | 55 | 142 | 83 | 127 | 593 | 271 | 247 | 357 | 843 | 9 | 27 | 62 | 185 | 83 | 196 | 521 |
| 9 | 10 | 2 | 338 | 303 | 342 | 858 | 10 | 31 | 73 | 233 | 80 | 152 | 443 | 236 | 192 | 181 | 1019 | 4 | 23 | 51 | 156 | 66 | 63 | 714 |
| 9 | 10 | 2 | 376 | 273 | 309 | 891 | 7 | 32 | 77 | 256 | 89 | 111 | 470 | 290 | 275 | 316 | 884 | 9 | 33 | 63 | 203 | 73 | 178 | 449 |
| 9 | 10 | 2 | 221 | 207 | 371 | 829 | 8 | 27 | 49 | 152 | 53 | 254 | 540 | 162 | 116 | 398 | 802 | 5 | 23 | 39 | 113 | 40 | 289 | 608 |
| 9 | 10 | 2 | 344 | 282 | 331 | 869 | 7 | 30 | 76 | 229 | 92 | 135 | 476 | 161 | 103 | 217 | 983 | 5 | 17 | 34 | 101 | 42 | 116 | 826 |
| 9 | 11 | 2 | 392 | 78 | 988 | 212 | 26 | 6 | 40 | 131 | 48 | 674 | 124 | 255 | 59 | 985 | 215 | 27 | 6 | 34 | 97 | 30 | 745 | 139 |
| 9 | 11 | 2 | 365 | 80 | 963 | 237 | 29 | 8 | 39 | 129 | 38 | 692 | 125 | 316 | 61 | 998 | 202 | 28 | 4 | 37 | 139 | 32 | 746 | 124 |
| 9 | 11 | 2 | 569 | 84 | 1005 | 195 | 31 | 6 | 44 | 147 | 41 | 528 | 73 | 296 | 57 | 1080 | 120 | 16 | 3 | 28 | 84 | 28 | 320 | 50 |
| 9 | 11 | 2 | 447 | 94 | 913 | 287 | 30 | 8 | 48 | 157 | 45 | 544 | 143 | 46 | 5 | 1195 | 5 | 2 | 0 | 2 | 7 | 2 | 21 | 0 |
| 9 | 11 | 2 | 468 | 115 | 975 | 225 | 31 | 5 | 53 | 168 | 58 | 515 | 72 | 153 | 40 | 1100 | 100 | 14 | 3 | 19 | 46 | 21 | 451 | 50 |
| 9 | 12 | 2 | 0 | 99 | 1 | 1199 | 0 | 16 | 0 | 0 | 0 | 0 | 952 | 0 | 45 | 0 | 1200 | 0 | 11 | 0 | 0 | 0 | 0 | 1121 |
| 9 | 12 | 2 | 1 | 33 | 56 | 1144 | 0 | 9 | 2 | 1 | 2 | 0 | 139 | 4 | 16 | 673 | 527 | 0 | 7 | 1 | 1 | 0 | 0 | 405 |
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| 9 | 12 | 2 | 3 | 164 | 7 | 1193 | 0 | 33 | 4 | 2 | 5 | 0 | 867 | 0 | 5 | 0 | 1200 | 0 | 2 | 0 | 0 | 0 | 0 | 1186 |
| 9 | 12 | 2 | 2 | 235 | 2 | 1198 | 0 | 39 | 2 | 2 | 2 | 0 | 713 | 0 | 64 | 0 | 1200 | 0 | 14 | 0 | 0 | 0 | 0 | 1031 |
| 9 | 13 | 2 | 375 | 202 | 676 | 524 | 14 | 12 | 72 | 230 | 71 | 459 | 274 | 417 | 168 | 578 | 622 | 16 | 17 | 80 | 264 | 60 | 389 | 388 |
| 9 | 13 | 2 | 354 | 158 | 651 | 549 | 16 | 16 | 69 | 227 | 74 | 477 | 357 | 204 | 72 | 882 | 318 | 11 | 8 | 39 | 134 | 34 | 771 | 236 |
| 9 | 13 | 2 | 434 | 207 | 650 | 550 | 16 | 16 | 71 | 247 | 89 | 447 | 334 | 264 | 82 | 823 | 377 | 12 | 9 | 33 | 117 | 32 | 674 | 285 |

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| 9 | 13 | 2 | 473 | 216 | 586 | 614 | 17 | 17 | 68 | 234 | 81 | 357 | 388 | 270 | 170 | 774 | 426 | 11 | 11 | 54 | 178 | 59 | 648 | 253 |
| 9 | 13 | 2 | 409 | 228 | 599 | 601 | 16 | 16 | 79 | 241 | 93 | 330 | 353 | 186 | 84 | 183 | 1017 | 6 | 6 | 34 | 120 | 37 | 99 | 115 |
| 9 | 14 | 4 | 470 | 117 | 623 | 577 | 12 | 12 | 36 | 245 | 60 | 430 | 426 | 429 | 87 | 642 | 558 | 11 | 12 | 32 | 224 | 54 | 469 | 440 |
| 9 | 14 | 4 | 513 | 144 | 650 | 550 | 14 | 13 | 57 | 344 | 86 | 424 | 355 | 381 | 116 | 658 | 542 | 13 | 13 | 45 | 306 | 55 | 491 | 384 |
| 9 | 14 | 4 | 417 | 109 | 649 | 551 | 12 | 12 | 39 | 246 | 72 | 459 | 409 | 326 | 130 | 590 | 610 | 10 | 9 | 40 | 229 | 68 | 442 | 460 |
| 9 | 14 | 4 | 415 | 120 | 588 | 612 | 12 | 13 | 45 | 276 | 67 | 391 | 406 | 174 | 66 | 554 | 646 | 8 | 8 | 24 | 121 | 38 | 408 | 469 |
| 9 | 14 | 4 | 481 | 148 | 579 | 621 | 14 | 14 | 41 | 260 | 74 | 357 | 394 | 386 | 137 | 654 | 546 | 14 | 12 | 41 | 259 | 65 | 468 | 375 |
| 9 | 15 | 4 | 74 | 204 | 147 | 1053 | 4 | 27 | 18 | 65 | 31 | 71 | 662 | 26 | 77 | 41 | 1159 | 1 | 17 | 4 | 20 | 7 | 27 | 490 |
| 9 | 15 | 4 | 219 | 291 | 204 | 996 | 3 | 31 | 30 | 159 | 44 | 104 | 588 | 109 | 192 | 137 | 1063 | 4 | 25 | 18 | 86 | 30 | 81 | 656 |
| 9 | 15 | 4 | 113 | 193 | 175 | 1025 | 4 | 24 | 19 | 87 | 32 | 111 | 658 | 85 | 137 | 162 | 1038 | 3 | 23 | 13 | 63 | 18 | 117 | 698 |
| 9 | 15 | 4 | 64 | 172 | 197 | 1003 | 3 | 28 | 12 | 53 | 24 | 158 | 636 | 13 | 23 | 41 | 1159 | 1 | 6 | 2 | 12 | 2 | 34 | 153 |
| 9 | 15 | 4 | 58 | 111 | 121 | 1079 | 1 | 27 | 12 | 41 | 19 | 53 | 653 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 1 | 0 | 170 | 167 | 577 | 623 | 15 | 16 | 90 | 45 | 45 | 383 | 443 | 40 | 32 | 1044 | 156 | 6 | 4 | 25 | 13 | 12 | 150 | 127 |
| 10 | 1 | 0 | 105 | 106 | 641 | 559 | 17 | 15 | 61 | 31 | 30 | 469 | 461 | 13 | 14 | 1141 | 59 | 4 | 2 | 8 | 4 | 4 | 257 | 45 |
| 10 | 1 | 0 | 124 | 130 | 624 | 576 | 17 | 15 | 79 | 40 | 39 | 454 | 429 | 195 | 87 | 733 | 467 | 12 | 13 | 64 | 32 | 32 | 394 | 375 |
| 10 | 1 | 0 | 94 | 124 | 602 | 598 | 16 | 15 | 75 | 38 | 37 | 438 | 459 | 40 | 37 | 1023 | 177 | 7 | 4 | 28 | 14 | 14 | 307 | 141 |
| 10 | 1 | 0 | 108 | 127 | 618 | 582 | 18 | 18 | 69 | 35 | 34 | 451 | 463 | 82 | 67 | 769 | 431 | 12 | 11 | 46 | 23 | 23 | 410 | 359 |
| 10 | 2 | 0 | 43 | 124 | 196 | 1004 | 5 | 31 | 36 | 18 | 18 | 143 | 778 | 37 | 112 | 122 | 1078 | 3 | 31 | 32 | 16 | 16 | 74 | 866 |
| 10 | 2 | 0 | 42 | 110 | 165 | 1035 | 4 | 27 | 40 | 20 | 20 | 107 | 795 | 36 | 51 | 199 | 1001 | 2 | 18 | 24 | 12 | 12 | 72 | 877 |
| 10 | 2 | 0 | 29 | 92 | 169 | 1031 | 4 | 27 | 26 | 13 | 13 | 115 | 826 | 3 | 21 | 33 | 1167 | 1 | 7 | 4 | 2 | 2 | 22 | 530 |
| 10 | 2 | 0 | 80 | 168 | 176 | 1024 | 4 | 31 | 54 | 27 | 27 | 52 | 734 | 58 | 129 | 164 | 1036 | 3 | 29 | 38 | 19 | 19 | 107 | 801 |
| 10 | 2 | 0 | 33 | 130 | 99 | 1101 | 2 | 31 | 34 | 17 | 17 | 55 | 852 | 58 | 128 | 169 | 1031 | 3 | 29 | 35 | 18 | 17 | 74 | 809 |
| 10 | 3 | 0 | 138 | 49 | 1036 | 164 | 30 | 3 | 44 | 22 | 22 | 803 | 81 | 40 | 5 | 609 | 591 | 15 | 1 | 5 | 2 | 3 | 478 | 28 |
| 10 | 3 | 0 | 253 | 108 | 669 | 531 | 20 | 3 | 69 | 34 | 35 | 240 | 43 | 46 | 27 | 678 | 522 | 8 | 1 | 21 | 11 | 10 | 613 | 2 |
| 10 | 3 | 0 | 164 | 51 | 1097 | 103 | 31 | 3 | 41 | 21 | 20 | 783 | 65 | 154 | 46 | 851 | 349 | 23 | 3 | 33 | 16 | 17 | 628 | 97 |
| 10 | 3 | 0 | 130 | 54 | 1036 | 164 | 29 | 4 | 38 | 19 | 19 | 834 | 120 | 103 | 38 | 1097 | 103 | 27 | 3 | 32 | 16 | 16 | 923 | 76 |
| 10 | 3 | 0 | 376 | 152 | 1036 | 164 | 36 | 3 | 86 | 43 | 43 | 578 | 71 | 173 | 69 | 1052 | 148 | 18 | 3 | 36 | 18 | 18 | 574 | 84 |
| 10 | 4 | 0 | 84 | 149 | 306 | 894 | 7 | 26 | 54 | 27 | 27 | 228 | 721 | 62 | 104 | 246 | 954 | 6 | 23 | 40 | 20 | 20 | 192 | 830 |
| 10 | 4 | 0 | 82 | 168 | 131 | 1069 | 2 | 17 | 55 | 27 | 28 | 12 | 583 | 47 | 74 | 284 | 916 | 3 | 10 | 28 | 14 | 14 | 212 | 241 |
| 10 | 4 | 0 | 40 | 82 | 277 | 923 | 7 | 26 | 32 | 16 | 16 | 206 | 780 | 67 | 118 | 255 | 945 | 6 | 24 | 43 | 22 | 21 | 190 | 781 |
| 10 | 4 | 0 | 74 | 128 | 265 | 935 | 7 | 24 | 61 | 31 | 30 | 181 | 735 | 41 | 107 | 200 | 1000 | 4 | 25 | 37 | 18 | 19 | 150 | 827 |
| 10 | 4 | 0 | 76 | 182 | 284 | 916 | 8 | 26 | 60 | 30 | 30 | 204 | 658 | 40 | 92 | 240 | 960 | 6 | 27 | 34 | 17 | 17 | 192 | 808 |
| 10 | 5 | 0 | 456 | 215 | 962 | 238 | 32 | 8 | 156 | 78 | 79 | 391 | 44 | 588 | 299 | 901 | 299 | 37 | 9 | 194 | 97 | 97 | 270 | 94 |
| 10 | 5 | 0 | 250 | 127 | 951 | 249 | 33 | 8 | 91 | 46 | 45 | 634 | 154 | 175 | 104 | 960 | 240 | 29 | 7 | 68 | 34 | 34 | 734 | 186 |
| 10 | 5 | 0 | 246 | 135 | 914 | 286 | 30 | 8 | 93 | 47 | 46 | 644 | 200 | 139 | 99 | 962 | 238 | 28 | 6 | 56 | 28 | 28 | 768 | 176 |
| 10 | 5 | 0 | 188 | 112 | 966 | 234 | 30 | 7 | 69 | 35 | 34 | 692 | 175 | 86 | 47 | 932 | 268 | 22 | 6 | 34 | 17 | 17 | 736 | 231 |
| 10 | 5 | 0 | 186 | 110 | 951 | 249 | 25 | 5 | 66 | 33 | 33 | 722 | 189 | 137 | 86 | 924 | 276 | 25 | 8 | 59 | 29 | 30 | 710 | 223 |
| 10 | 6 | 0 | 148 | 188 | 608 | 592 | 18 | 17 | 85 | 43 | 42 | 451 | 420 | 62 | 101 | 627 | 573 | 16 | 15 | 42 | 21 | 21 | 546 | 461 |
| 10 | 6 | 0 | 87 | 130 | 605 | 595 | 16 | 16 | 66 | 33 | 33 | 486 | 458 | 125 | 145 | 606 | 594 | 16 | 16 | 79 | 40 | 39 | 459 | 484 |
| 10 | 6 | 0 | 111 | 128 | 543 | 657 | 15 | 16 | 71 | 35 | 36 | 433 | 472 | 86 | 105 | 588 | 612 | 15 | 14 | 50 | 25 | 25 | 493 | 500 |
| 10 | 6 | 0 | 94 | 121 | 516 | 684 | 15 | 15 | 69 | 35 | 34 | 422 | 502 | 69 | 96 | 608 | 592 | 14 | 15 | 45 | 22 | 23 | 534 | 463 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 6 | 0 | 86 | 134 | 547 | 653 | 15 | 15 | 68 | 34 | 34 | 453 | 493 | 63 | 75 | 551 | 649 | 14 | 14 | 45 | 23 | 22 | 467 | 516 |
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| 10 | 7 | 2 | 334 | 295 | 591 | 609 | 15 | 16 | 70 | 226 | 211 | 409 | 433 | 251 | 256 | 603 | 597 | 13 | 13 | 53 | 168 | 163 | 447 | 470 |
| 10 | 7 | 2 | 203 | 264 | 585 | 615 | 14 | 14 | 53 | 152 | 158 | 453 | 468 | 201 | 267 | 619 | 581 | 13 | 13 | 49 | 141 | 167 | 503 | 461 |
| 10 | 7 | 2 | 309 | 293 | 566 | 634 | 13 | 14 | 71 | 199 | 216 | 381 | 459 | 279 | 264 | 580 | 620 | 13 | 12 | 60 | 182 | 185 | 434 | 483 |
| 10 | 7 | 2 | 298 | 283 | 595 | 605 | 13 | 13 | 70 | 203 | 198 | 428 | 445 | 245 | 269 | 584 | 616 | 12 | 13 | 50 | 143 | 179 | 447 | 502 |
| 10 | 8 | 2 | 21 | 36 | 57 | 1143 | 1 | 4 | 8 | 19 | 18 | 44 | 180 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 8 | 2 | 29 | 110 | 101 | 1099 | 2 | 23 | 12 | 26 | 35 | 72 | 940 | 1 | 13 | 8 | 1192 | 0 | 3 | 2 | 1 | 1 | 0 | 195 |
| 10 | 8 | 2 | 66 | 144 | 186 | 1014 | 3 | 21 | 24 | 55 | 57 | 142 | 768 | 27 | 80 | 112 | 1088 | 3 | 22 | 8 | 22 | 21 | 93 | 886 |
| 10 | 8 | 2 | 74 | 140 | 181 | 1019 | 4 | 25 | 20 | 60 | 50 | 140 | 802 | 32 | 89 | 154 | 1046 | 3 | 23 | 10 | 26 | 23 | 132 | 900 |
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| 10 | 9 | 2 | 160 | 47 | 1099 | 101 | 28 | 2 | 18 | 55 | 32 | 918 | 60 | 82 | 38 | 985 | 215 | 19 | 4 | 16 | 37 | 30 | 866 | 182 |
| 10 | 9 | 2 | 165 | 58 | 1052 | 148 | 27 | 3 | 20 | 59 | 47 | 873 | 97 | 59 | 14 | 1115 | 85 | 25 | 2 | 5 | 9 | 12 | 956 | 72 |
| 10 | 9 | 2 | 78 | 35 | 1100 | 100 | 25 | 2 | 8 | 21 | 24 | 930 | 65 | 52 | 13 | 1098 | 102 | 21 | 2 | 4 | 9 | 11 | 986 | 91 |
| 10 | 9 | 2 | 153 | 51 | 1042 | 158 | 25 | 4 | 19 | 55 | 37 | 841 | 109 | 80 | 40 | 1004 | 196 | 21 | 3 | 11 | 30 | 28 | 864 | 173 |
| 10 | 9 | 2 | 155 | 54 | 1045 | 155 | 27 | 3 | 18 | 54 | 41 | 852 | 112 | 115 | 55 | 940 | 260 | 20 | 4 | 20 | 52 | 41 | 736 | 225 |
| 10 | 10 | 2 | 66 | 185 | 192 | 1008 | 4 | 24 | 26 | 54 | 65 | 129 | 786 | 73 | 146 | 245 | 955 | 6 | 22 | 26 | 58 | 61 | 183 | 805 |
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| 10 | 10 | 2 | 82 | 175 | 282 | 918 | 7 | 23 | 30 | 66 | 76 | 205 | 718 | 76 | 179 | 239 | 961 | 5 | 22 | 28 | 59 | 62 | 178 | 781 |
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| 10 | 10 | 2 | 119 | 212 | 191 | 1009 | 4 | 23 | 34 | 102 | 69 | 123 | 743 | 59 | 111 | 268 | 932 | 4 | 16 | 19 | 51 | 49 | 220 | 749 |
| 10 | 11 | 2 | 243 | 94 | 912 | 288 | 24 | 7 | 30 | 90 | 69 | 658 | 192 | 171 | 88 | 963 | 237 | 25 | 4 | 27 | 77 | 57 | 722 | 181 |
| 10 | 11 | 2 | 138 | 45 | 1013 | 187 | 26 | 4 | 18 | 47 | 35 | 791 | 124 | 179 | 71 | 914 | 286 | 21 | 7 | 24 | 62 | 51 | 685 | 223 |
| 10 | 11 | 2 | 150 | 69 | 944 | 256 | 23 | 6 | 24 | 49 | 54 | 680 | 187 | 130 | 50 | 938 | 262 | 21 | 6 | 18 | 42 | 38 | 742 | 214 |
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| 10 | 13 | 2 | 107 | 96 | 470 | 730 | 10 | 12 | 35 | 74 | 52 | 384 | 601 | 145 | 98 | 527 | 673 | 11 | 10 | 36 | 86 | 51 | 407 | 548 |
| 10 | 13 | 2 | 193 | 113 | 618 | 582 | 14 | 13 | 45 | 123 | 59 | 473 | 458 | 107 | 77 | 549 | 651 | 10 | 10 | 27 | 62 | 34 | 465 | 562 |
| 10 | 13 | 2 | 206 | 127 | 620 | 580 | 14 | 14 | 48 | 116 | 69 | 455 | 428 | 119 | 76 | 621 | 579 | 9 | 10 | 34 | 72 | 41 | 508 | 392 |
| 10 | 13 | 2 | 202 | 122 | 586 | 614 | 14 | 14 | 54 | 129 | 72 | 442 | 460 | 114 | 79 | 609 | 591 | 11 | 10 | 32 | 87 | 39 | 527 | 508 |
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| 10 | 14 | 4 | 211 | 120 | 555 | 645 | 10 | 11 | 38 | 182 | 76 | 445 | 482 | 160 | 74 | 689 | 511 | 7 | 8 | 25 | 107 | 47 | 596 | 435 |
| 10 | 14 | 4 | 276 | 108 | 639 | 561 | 11 | 10 | 37 | 203 | 75 | 497 | 437 | 180 | 75 | 552 | 648 | 7 | 7 | 26 | 139 | 54 | 463 | 573 |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 10 | 16 | 4 | 81 | 21 | 1067 | 133 | 26 | 3 | 8 | 16 | 18 | 835 | 95 | 64 | 26 | 1082 | 118 | 23 | 2 | 10 | 22 | 20 | 712 | 70 |
| 10 | 16 | 4 | 94 | 50 | 1071 | 129 | 25 | 2 | 14 | 35 | 34 | 789 | 56 | 44 | 27 | 1114 | 86 | 21 | 2 | 6 | 12 | 20 | 749 | 65 |
| 10 | 16 | 4 | 92 | 36 | 1082 | 118 | 27 | 2 | 10 | 29 | 27 | 830 | 71 | 47 | 15 | 1103 | 97 | 20 | 3 | 5 | 3 | 12 | 623 | 74 |
| 10 | 16 | 4 | 53 | 15 | 1075 | 125 | 23 | 3 | 6 | 5 | 12 | 709 | 89 | 76 | 32 | 1066 | 134 | 21 | 3 | 10 | 22 | 24 | 742 | 106 |
| 10 | 17 | 4 | 74 | 102 | 238 | 962 | 5 | 19 | 18 | 55 | 34 | 173 | 629 | 45 | 70 | 243 | 957 | 4 | 21 | 16 | 37 | 32 | 154 | 762 |
| 10 | 17 | 4 | 134 | 152 | 272 | 928 | 5 | 18 | 27 | 101 | 74 | 180 | 614 | 48 | 63 | 202 | 998 | 4 | 22 | 13 | 40 | 18 | 166 | 641 |
| 10 | 17 | 4 | 171 | 152 | 244 | 956 | 4 | 21 | 26 | 125 | 66 | 138 | 585 | 49 | 61 | 238 | 962 | 5 | 18 | 12 | 44 | 18 | 198 | 615 |
| 10 | 17 | 4 | 61 | 88 | 182 | 1018 | 4 | 23 | 16 | 53 | 24 | 131 | 721 | 38 | 69 | 234 | 966 | 5 | 16 | 10 | 33 | 19 | 197 | 541 |
| 10 | 17 | 4 | 70 | 105 | 239 | 961 | 5 | 20 | 20 | 60 | 35 | 170 | 573 | 56 | 63 | 228 | 972 | 4 | 17 | 18 | 44 | 27 | 172 | 682 |
| 10 | 18 | 4 | 86 | 30 | 1011 | 189 | 20 | 4 | 12 | 20 | 25 | 758 | 136 | 61 | 27 | 994 | 206 | 18 | 4 | 10 | 16 | 21 | 768 | 172 |
| 10 | 18 | 4 | 104 | 53 | 919 | 281 | 20 | 5 | 20 | 43 | 43 | 728 | 190 | 84 | 47 | 985 | 215 | 21 | 4 | 18 | 32 | 28 | 820 | 160 |
| 10 | 18 | 4 | 150 | 91 | 882 | 318 | 19 | 5 | 36 | 88 | 57 | 630 | 179 | 63 | 43 | 944 | 256 | 17 | 5 | 14 | 28 | 34 | 655 | 206 |
| 10 | 18 | 4 | 120 | 71 | 948 | 252 | 20 | 6 | 25 | 53 | 52 | 690 | 161 | 37 | 14 | 952 | 248 | 15 | 5 | 9 | 8 | 9 | 672 | 216 |
| 10 | 18 | 4 | 127 | 73 | 929 | 271 | 20 | 6 | 27 | 66 | 54 | 706 | 169 | 61 | 41 | 956 | 244 | 16 | 4 | 15 | 30 | 29 | 636 | 199 |
| 10 | 19 | 4 | 197 | 185 | 612 | 588 | 13 | 11 | 48 | 139 | 134 | 462 | 415 | 149 | 123 | 487 | 713 | 8 | 12 | 41 | 104 | 81 | 372 | 566 |
| 10 | 19 | 4 | 208 | 194 | 565 | 635 | 11 | 11 | 54 | 166 | 134 | 407 | 440 | 108 | 106 | 621 | 579 | 12 | 11 | 31 | 83 | 75 | 520 | 461 |
| 10 | 19 | 4 | 203 | 157 | 655 | 545 | 12 | 10 | 43 | 141 | 102 | 476 | 378 | 177 | 162 | 611 | 589 | 12 | 11 | 42 | 135 | 111 | 479 | 446 |
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| 10 | 19 | 4 | 214 | 169 | 532 | 668 | 12 | 13 | 42 | 162 | 112 | 398 | 445 | 191 | 138 | 583 | 617 | 12 | 11 | 47 | 131 | 96 | 446 | 474 |
| 10 | 20 | 6 | 269 | 151 | 492 | 708 | 10 | 12 | 29 | 218 | 87 | 350 | 482 | 221 | 112 | 632 | 568 | 9 | 10 | 34 | 179 | 86 | 394 | 365 |
| 10 | 20 | 6 | 454 | 225 | 633 | 541 | 11 | 10 | 56 | 405 | 158 | 347 | 318 | 361 | 203 | 522 | 678 | 9 | 10 | 40 | 290 | 133 | 351 | 430 |
| 10 | 20 | 6 | 317 | 159 | 535 | 665 | 10 | 12 | 37 | 278 | 89 | 367 | 417 | 253 | 124 | 479 | 721 | 10 | 8 | 27 | 205 | 80 | 344 | 342 |
| 10 | 20 | 6 | 322 | 202 | 557 | 643 | 11 | 11 | 48 | 246 | 132 | 290 | 335 | 323 | 160 | 572 | 628 | 10 | 11 | 42 | 271 | 116 | 406 | 402 |
| 10 | 20 | 6 | 265 | 119 | 541 | 659 | 10 | 12 | 32 | 225 | 83 | 388 | 488 | 237 | 117 | 646 | 554 | 12 | 10 | 32 | 187 | 80 | 421 | 394 |
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| 10 | 22 | 6 | 129 | 37 | 991 | 209 | 18 | 3 | 16 | 50 | 32 | 628 | 135 | 69 | 26 | 1025 | 175 | 17 | 3 | 8 | 25 | 23 | 685 | 140 |
| 10 | 22 | 6 | 39 | 14 | 1088 | 112 | 23 | 2 | 4 | 6 | 12 | 910 | 60 | 37 | 29 | 1030 | 170 | 15 | 2 | 10 | 12 | 22 | 609 | 86 |
| 10 | 22 | 6 | 50 | 31 | 1077 | 122 | 21 | 2 | 8 | 14 | 24 | 813 | 72 | 48 | 11 | 1097 | 103 | 19 | 2 | 4 | 3 | 9 | 731 | 84 |
| 10 | 22 | 6 | 84 | 53 | 1028 | 172 | 21 | 2 | 18 | 49 | 34 | 735 | 90 | 82 | 32 | 989 | 211 | 13 | 3 | 16 | 36 | 29 | 530 | 124 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 23 | 6 | 140 | 103 | 304 | 896 | 7 | 18 | 17 | 129 | 32 | 229 | 668 | 40 | 51 | 198 | 1002 | 3 | 18 | 7 | 37 | 9 | 170 | 658 |
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| 10 | 23 | 6 | 159 | 99 | 282 | 918 | 6 | 19 | 20 | 128 | 38 | 178 | 696 | 57 | 58 | 267 | 933 | 4 | 17 | 13 | 49 | 18 | 210 | 752 |
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| 10 | 24 | 6 | 83 | 26 | 990 | 210 | 21 | 4 | 9 | 13 | 19 | 713 | 136 | 79 | 46 | 939 | 261 | 15 | 4 | 17 | 32 | 42 | 598 | 170 |
| 10 | 24 | 6 | 147 | 93 | 896 | 304 | 20 | 4 | 30 | 77 | 52 | 583 | 123 | 87 | 31 | 1008 | 192 | 15 | 4 | 14 | 34 | 27 | 522 | 135 |
| 10 | 24 | 6 | 105 | 27 | 1014 | 186 | 17 | 4 | 10 | 21 | 23 | 544 | 130 | 70 | 27 | 1035 | 165 | 16 | 3 | 12 | 16 | 24 | 659 | 120 |
| 10 | 24 | 6 | 157 | 56 | 878 | 322 | 17 | 6 | 24 | 84 | 41 | 536 | 203 | 60 | 26 | 1024 | 176 | 13 | 3 | 8 | 21 | 17 | 567 | 138 |
| 10 | 25 | 6 | 91 | 75 | 645 | 555 | 13 | 11 | 24 | 53 | 52 | 448 | 427 | 77 | 56 | 732 | 468 | 8 | 9 | 20 | 47 | 34 | 355 | 360 |
| 10 | 25 | 6 | 123 | 92 | 668 | 532 | 11 | 10 | 30 | 86 | 60 | 419 | 337 | 165 | 96 | 639 | 561 | 7 | 9 | 28 | 127 | 70 | 296 | 439 |
| 10 | 25 | 6 | 162 | 104 | 568 | 632 | 10 | 11 | 28 | 128 | 57 | 329 | 438 | 99 | 73 | 747 | 453 | 8 | 7 | 23 | 75 | 50 | 417 | 275 |
| 10 | 25 | 6 | 179 | 130 | 603 | 597 | 11 | 10 | 30 | 135 | 71 | 334 | 345 | 51 | 41 | 800 | 400 | 9 | 8 | 15 | 17 | 32 | 366 | 315 |
| 10 | 25 | 6 | 140 | 118 | 603 | 597 | 9 | 11 | 29 | 96 | 94 | 336 | 426 | 51 | 41 | 826 | 374 | 7 | 6 | 13 | 16 | 35 | 307 | 321 |
| 11 | 1 | 0 | 263 | 338 | 527 | 673 | 18 | 20 | 136 | 68 | 68 | 133 | 189 | 272 | 306 | 631 | 569 | 22 | 20 | 131 | 65 | 66 | 186 | 221 |
| 11 | 1 | 0 | 252 | 300 | 573 | 627 | 21 | 20 | 120 | 60 | 61 | 192 | 244 | 213 | 265 | 513 | 687 | 18 | 18 | 120 | 60 | 60 | 182 | 254 |
| 11 | 1 | 0 | 202 | 284 | 598 | 602 | 18 | 18 | 120 | 60 | 60 | 196 | 267 | 200 | 234 | 591 | 609 | 18 | 20 | 119 | 59 | 60 | 231 | 286 |
| 11 | 1 | 0 | 146 | 179 | 714 | 486 | 15 | 17 | 85 | 42 | 43 | 266 | 267 | 51 | 78 | 703 | 497 | 11 | 8 | 35 | 18 | 17 | 472 | 364 |
| 11 | 1 | 0 | 236 | 350 | 653 | 547 | 21 | 20 | 152 | 76 | 76 | 187 | 227 | 200 | 278 | 671 | 529 | 17 | 18 | 133 | 66 | 67 | 260 | 225 |
| 11 | 2 | 0 | 119 | 617 | 166 | 1034 | 6 | 40 | 108 | 54 | 54 | 26 | 354 | 154 | 648 | 173 | 1027 | 5 | 41 | 136 | 68 | 68 | 16 | 320 |
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| 11 | 2 | 0 | 88 | 463 | 148 | 1052 | 4 | 37 | 78 | 40 | 39 | 35 | 354 | 114 | 409 | 124 | 1076 | 3 | 39 | 88 | 45 | 44 | 19 | 378 |
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| 11 | 3 | 0 | 345 | 158 | 872 | 328 | 34 | 4 | 124 | 62 | 62 | 316 | 31 | 323 | 172 | 950 | 250 | 37 | 5 | 112 | 56 | 56 | 437 | 37 |
| 11 | 3 | 0 | 296 | 118 | 1023 | 177 | 37 | 5 | 78 | 39 | 39 | 447 | 61 | 342 | 162 | 981 | 219 | 37 | 4 | 106 | 53 | 54 | 338 | 34 |
| 11 | 3 | 0 | 351 | 137 | 954 | 246 | 37 | 4 | 104 | 52 | 52 | 317 | 36 | 290 | 101 | 1051 | 149 | 37 | 4 | 66 | 33 | 33 | 442 | 62 |
| 11 | 3 | 0 | 319 | 148 | 1011 | 189 | 31 | 3 | 102 | 51 | 51 | 545 | 16 | 387 | 118 | 1028 | 172 | 39 | 4 | 84 | 42 | 42 | 333 | 43 |
| 11 | 3 | 0 | 306 | 121 | 840 | 360 | 30 | 2 | 98 | 49 | 49 | 351 | 44 | 391 | 139 | 1001 | 199 | 40 | 6 | 116 | 58 | 58 | 338 | 55 |
| 11 | 4 | 0 | 109 | 245 | 170 | 1030 | 6 | 28 | 93 | 47 | 46 | 57 | 455 | 84 | 183 | 269 | 931 | 6 | 25 | 73 | 36 | 37 | 151 | 471 |
| 11 | 4 | 0 | 106 | 214 | 186 | 1014 | 7 | 26 | 91 | 45 | 46 | 61 | 465 | 66 | 110 | 203 | 997 | 5 | 25 | 58 | 29 | 29 | 122 | 605 |
| 11 | 4 | 0 | 126 | 283 | 261 | 939 | 8 | 29 | 102 | 51 | 53 | 112 | 390 | 140 | 303 | 243 | 957 | 7 | 31 | 104 | 52 | 52 | 53 | 466 |
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| 11 | 5 | 0 | 155 | 61 | 828 | 372 | 26 | 5 | 46 | 23 | 23 | 392 | 55 | 228 | 101 | 925 | 275 | 30 | 8 | 68 | 34 | 34 | 464 | 97 |
| 11 | 5 | 0 | 284 | 173 | 891 | 309 | 34 | 9 | 104 | 52 | 52 | 440 | 101 | 347 | 258 | 803 | 397 | 35 | 8 | 151 | 75 | 76 | 281 | 98 |
| 11 | 5 | 0 | 414 | 292 | 792 | 408 | 37 | 7 | 191 | 95 | 96 | 242 | 37 | 337 | 146 | 931 | 269 | 31 | 10 | 109 | 55 | 54 | 295 | 84 |
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| 11 | 5 | 0 | 385 | 260 | 841 | 359 | 34 | 8 | 160 | 80 | 80 | 264 | 54 | 313 | 144 | 970 | 230 | 34 | 8 | 98 | 49 | 49 | 415 | 94 |
| 11 | 6 | 0 | 360 | 381 | 612 | 588 | 24 | 24 | 182 | 91 | 91 | 189 | 180 | 247 | 228 | 688 | 512 | 18 | 18 | 116 | 58 | 58 | 221 | 184 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 11 | 6 | 0 | 384 | 395 | 578 | 622 | 24 | 23 | 194 | 97 | 97 | 167 | 193 | 243 | 244 | 650 | 550 | 19 | 19 | 126 | 63 | 63 | 227 | 185 |
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| 11 | 6 | 0 | 336 | 340 | 572 | 622 | 22 | 22 | 182 | 91 | 91 | 138 | 219 | 273 | 281 | 619 | 581 | 20 | 22 | 152 | 76 | 76 | 215 | 187 |
| 11 | 7 | 2 | 296 | 326 | 446 | 754 | 13 | 14 | 69 | 173 | 141 | 127 | 180 | 391 | 372 | 687 | 513 | 19 | 18 | 85 | 188 | 159 | 219 | 190 |
| 11 | 7 | 2 | 264 | 216 | 473 | 727 | 13 | 11 | 52 | 139 | 98 | 180 | 114 | 383 | 369 | 727 | 473 | 15 | 18 | 80 | 189 | 174 | 315 | 180 |
| 11 | 7 | 2 | 357 | 381 | 603 | 597 | 17 | 17 | 82 | 193 | 183 | 193 | 250 | 263 | 263 | 648 | 552 | 15 | 16 | 65 | 143 | 155 | 263 | 283 |
| 11 | 7 | 2 | 222 | 193 | 820 | 380 | 14 | 14 | 49 | 105 | 98 | 137 | 194 | 175 | 167 | 791 | 409 | 13 | 13 | 52 | 92 | 109 | 282 | 269 |
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| 11 | 8 | 2 | 140 | 563 | 130 | 1070 | 4 | 36 | 50 | 106 | 71 | 18 | 365 | 181 | 580 | 168 | 1032 | 3 | 36 | 64 | 127 | 73 | 16 | 347 |
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| 11 | 8 | 2 | 19 | 161 | 198 | 1002 | 1 | 16 | 12 | 17 | 15 | 21 | 464 | 93 | 403 | 145 | 1055 | 3 | 30 | 43 | 70 | 49 | 28 | 415 |
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| 11 | 8 | 2 | 73 | 402 | 101 | 1099 | 3 | 30 | 40 | 59 | 70 | 26 | 325 | 126 | 528 | 193 | 1007 | 5 | 37 | 62 | 102 | 102 | 79 | 333 |
| 11 | 9 | 2 | 464 | 115 | 1041 | 159 | 36 | 3 | 50 | 83 | 76 | 345 | 27 | 563 | 95 | 1049 | 151 | 36 | 5 | 38 | 85 | 60 | 205 | 51 |
| 11 | 9 | 2 | 541 | 47 | 976 | 224 | 29 | 4 | 22 | 48 | 29 | 208 | 146 | 423 | 46 | 1119 | 81 | 31 | 5 | 17 | 40 | 35 | 301 | 36 |
| 11 | 9 | 2 | 372 | 58 | 1083 | 117 | 35 | 3 | 22 | 38 | 28 | 346 | 36 | 396 | 87 | 1065 | 135 | 32 | 6 | 28 | 54 | 54 | 342 | 63 |
| 11 | 9 | 2 | 210 | 17 | 942 | 258 | 21 | 2 | 8 | 17 | 11 | 401 | 41 | 377 | 43 | 1108 | 92 | 28 | 4 | 18 | 36 | 33 | 308 | 41 |
| 11 | 9 | 2 | 414 | 69 | 1077 | 123 | 31 | 4 | 30 | 59 | 48 | 318 | 42 | 373 | 75 | 1025 | 175 | 31 | 3 | 32 | 61 | 47 | 205 | 33 |
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| 11 | 10 | 2 | 133 | 261 | 325 | 875 | 6 | 19 | 68 | 82 | 92 | 60 | 271 | 91 | 189 | 263 | 937 | 4 | 25 | 52 | 59 | 83 | 69 | 482 |
| 11 | 10 | 2 | 130 | 284 | 213 | 987 | 7 | 24 | 48 | 81 | 63 | 65 | 401 | 63 | 154 | 109 | 1091 | 2 | 16 | 26 | 37 | 46 | 5 | 775 |
| 11 | 10 | 2 | 38 | 122 | 215 | 985 | 4 | 13 | 23 | 30 | 25 | 149 | 257 | 99 | 161 | 227 | 973 | 4 | 21 | 39 | 62 | 42 | 57 | 321 |
| 11 | 11 | 2 | 544 | 135 | 779 | 421 | 25 | 8 | 62 | 129 | 72 | 184 | 87 | 637 | 231 | 859 | 341 | 33 | 8 | 75 | 159 | 92 | 157 | 81 |
| 11 | 11 | 2 | 475 | 134 | 974 | 226 | 28 | 6 | 50 | 112 | 54 | 362 | 62 | 635 | 203 | 902 | 298 | 34 | 10 | 69 | 136 | 94 | 206 | 81 |
| 11 | 11 | 2 | 590 | 242 | 853 | 347 | 33 | 8 | 82 | 178 | 107 | 203 | 77 | 573 | 266 | 840 | 360 | 32 | 7 | 76 | 166 | 101 | 203 | 78 |
| 11 | 11 | 2 | 656 | 204 | 861 | 339 | 32 | 7 | 81 | 176 | 106 | 168 | 72 | 695 | 227 | 883 | 317 | 33 | 9 | 75 | 172 | 89 | 182 | 67 |
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| 11 | 13 | 2 | 348 | 206 | 616 | 582 | 18 | 16 | 71 | 185 | 65 | 336 | 199 | 457 | 280 | 570 | 630 | 19 | 23 | 93 | 250 | 85 | 176 | 226 |
| 11 | 13 | 2 | 284 | 163 | 535 | 665 | 16 | 15 | 59 | 155 | 59 | 231 | 239 | 342 | 220 | 553 | 647 | 15 | 15 | 78 | 178 | 78 | 129 | 320 |
| 11 | 13 | 2 | 189 | 96 | 423 | 777 | 11 | 9 | 40 | 107 | 31 | 274 | 261 | 416 | 205 | 540 | 660 | 16 | 19 | 77 | 196 | 73 | 218 | 297 |
| 11 | 13 | 2 | 422 | 214 | 465 | 735 | 17 | 17 | 78 | 214 | 77 | 158 | 422 | 429 | 246 | 537 | 663 | 16 | 16 | 93 | 226 | 93 | 193 | 207 |
| 11 | 13 | 2 | 43 | 46 | 260 | 940 | 5 | 5 | 13 | 31 | 11 | 129 | 183 | 121 | 74 | 610 | 590 | 12 | 11 | 32 | 73 | 30 | 370 | 324 |
| 11 | 14 | 4 | 495 | 331 | 598 | 602 | 16 | 16 | 70 | 328 | 172 | 128 | 150 | 540 | 363 | 543 | 657 | 18 | 17 | 76 | 362 | 176 | 88 | 192 |
| 11 | 14 | 4 | 341 | 176 | 655 | 546 | 12 | 12 | 44 | 173 | 99 | 188 | 231 | 537 | 260 | 631 | 569 | 15 | 14 | 64 | 301 | 143 | 89 | 137 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 14 | 4 | 536 | 409 | 541 | 659 | 17 | 16 | 71 | 340 | 173 | 159 | 139 | 628 | 366 | 573 | 627 | 19 | 19 | 82 | 402 | 189 | 90 | 114 |
| 11 | 14 | 4 | 515 | 296 | 544 | 656 | 18 | 17 | 69 | 321 | 145 | 132 | 166 | 411 | 236 | 802 | 398 | 12 | 12 | 44 | 200 | 106 | 81 | 86 |
| 11 | 14 | 4 | 501 | 358 | 512 | 688 | 15 | 16 | 60 | 281 | 136 | 97 | 202 | 549 | 418 | 611 | 589 | 18 | 17 | 69 | 295 | 179 | 120 | 113 |
| 11 | 15 | 4 | 159 | 537 | 205 | 995 | 6 | 27 | 33 | 138 | 67 | 66 | 262 | 252 | 493 | 213 | 987 | 3 | 34 | 45 | 207 | 105 | 43 | 278 |
| 11 | 15 | 4 | 184 | 583 | 144 | 1056 | 3 | 37 | 35 | 151 | 66 | 24 | 347 | 232 | 535 | 195 | 1005 | 5 | 30 | 37 | 185 | 81 | 53 | 366 |
| 11 | 15 | 4 | 235 | 572 | 219 | 981 | 4 | 33 | 44 | 185 | 103 | 52 | 277 | 181 | 534 | 135 | 1065 | 3 | 36 | 30 | 143 | 78 | 21 | 392 |
| 11 | 15 | 4 | 172 | 622 | 147 | 1043 | 5 | 35 | 32 | 148 | 81 | 37 | 318 | 230 | 576 | 202 | 998 | 5 | 37 | 38 | 175 | 90 | 39 | 285 |
| 11 | 15 | 4 | 235 | 612 | 224 | 976 | 6 | 31 | 42 | 188 | 100 | 53 | 160 | 248 | 658 | 178 | 1022 | 4 | 33 | 44 | 203 | 109 | 26 | 232 |
| 11 | 16 | 4 | 656 | 88 | 996 | 204 | 28 | 4 | 24 | 122 | 64 | 229 | 12 | 715 | 115 | 1003 | 197 | 27 | 5 | 36 | 191 | 68 | 170 | 60 |
| 11 | 16 | 4 | 748 | 100 | 1001 | 199 | 30 | 2 | 34 | 157 | 54 | 225 | 14 | 613 | 93 | 1010 | 190 | 34 | 5 | 34 | 177 | 60 | 324 | 59 |
| 11 | 16 | 4 | 620 | 62 | 1078 | 122 | 28 | 4 | 16 | 80 | 43 | 277 | 34 | 660 | 122 | 998 | 202 | 30 | 4 | 36 | 188 | 80 | 224 | 50 |
| 11 | 16 | 4 | 497 | 53 | 1054 | 146 | 32 | 3 | 22 | 91 | 38 | 297 | 37 | 549 | 63 | 1000 | 200 | 30 | 4 | 22 | 116 | 40 | 244 | 105 |
| 11 | 16 | 4 | 335 | 33 | 1049 | 151 | 23 | 2 | 18 | 70 | 27 | 262 | 26 | 398 | 40 | 1010 | 190 | 27 | 3 | 16 | 51 | 24 | 130 | 85 |
| 11 | 17 | 4 | 160 | 457 | 153 | 1047 | 5 | 26 | 54 | 127 | 142 | 19 | 210 | 118 | 272 | 236 | 964 | 4 | 19 | 34 | 81 | 72 | 11 | 207 |
| 11 | 17 | 4 | 227 | 273 | 320 | 880 | 4 | 22 | 51 | 158 | 98 | 20 | 283 | 112 | 292 | 209 | 991 | 6 | 19 | 31 | 90 | 78 | 29 | 146 |
| 11 | 17 | 4 | 54 | 168 | 96 | 1104 | 2 | 11 | 36 | 47 | 57 | 7 | 227 | 103 | 231 | 152 | 1048 | 4 | 17 | 23 | 82 | 46 | 29 | 182 |
| 11 | 17 | 4 | 107 | 260 | 128 | 1072 | 6 | 18 | 17 | 79 | 34 | 51 | 297 | 108 | 234 | 119 | 1081 | 4 | 18 | 19 | 74 | 40 | 20 | 196 |
| 11 | 17 | 4 | 216 | 307 | 336 | 864 | 5 | 22 | 36 | 150 | 78 | 33 | 244 | 176 | 399 | 262 | 938 | 6 | 25 | 33 | 133 | 87 | 52 | 259 |
| 11 | 18 | 4 | 306 | 71 | 813 | 387 | 21 | 4 | 18 | 56 | 38 | 165 | 41 | 365 | 116 | 890 | 310 | 26 | 7 | 36 | 119 | 63 | 133 | 85 |
| 11 | 18 | 4 | 458 | 94 | 948 | 252 | 28 | 5 | 29 | 148 | 51 | 220 | 73 | 541 | 126 | 917 | 283 | 25 | 8 | 42 | 184 | 81 | 158 | 90 |
| 11 | 18 | 4 | 443 | 111 | 839 | 361 | 22 | 4 | 31 | 133 | 61 | 239 | 63 | 512 | 150 | 845 | 355 | 30 | 9 | 41 | 202 | 70 | 204 | 100 |
| 11 | 18 | 4 | 414 | 134 | 910 | 290 | 23 | 4 | 36 | 166 | 70 | 363 | 22 | 426 | 116 | 806 | 394 | 23 | 6 | 40 | 176 | 53 | 215 | 157 |
| 11 | 18 | 4 | 310 | 82 | 955 | 245 | 24 | 5 | 22 | 101 | 39 | 227 | 48 | 508 | 124 | 862 | 338 | 28 | 8 | 36 | 164 | 69 | 119 | 116 |
| 11 | 19 | 4 | 411 | 208 | 632 | 568 | 15 | 14 | 46 | 236 | 73 | 122 | 141 | 566 | 396 | 519 | 681 | 19 | 20 | 61 | 308 | 140 | 94 | 177 |
| 11 | 19 | 4 | 396 | 300 | 506 | 694 | 14 | 15 | 48 | 239 | 83 | 68 | 161 | 482 | 338 | 487 | 713 | 15 | 15 | 56 | 270 | 107 | 49 | 166 |
| 11 | 19 | 4 | 346 | 275 | 447 | 753 | 16 | 15 | 43 | 219 | 83 | 147 | 149 | 331 | 243 | 507 | 693 | 15 | 16 | 45 | 172 | 78 | 78 | 185 |
| 11 | 19 | 4 | 299 | 201 | 401 | 799 | 11 | 11 | 36 | 156 | 76 | 79 | 161 | 363 | 164 | 570 | 630 | 13 | 15 | 34 | 165 | 66 | 43 | 187 |
| 11 | 19 | 4 | 145 | 112 | 521 | 679 | 7 | 5 | 22 | 91 | 39 | 33 | 147 | 242 | 184 | 406 | 794 | 11 | 12 | 34 | 147 | 69 | 61 | 154 |
| 11 | 20 | 6 | 346 | 197 | 625 | 575 | 10 | 9 | 34 | 227 | 93 | 251 | 86 | 468 | 295 | 525 | 675 | 16 | 16 | 40 | 282 | 114 | 91 | 129 |
| 11 | 20 | 6 | 406 | 298 | 447 | 753 | 14 | 14 | 39 | 277 | 123 | 111 | 114 | 486 | 372 | 511 | 689 | 16 | 16 | 48 | 310 | 145 | 87 | 130 |
| 11 | 20 | 6 | 500 | 341 | 539 | 661 | 15 | 15 | 49 | 290 | 148 | 95 | 143 | 459 | 329 | 506 | 694 | 15 | 14 | 47 | 306 | 134 | 74 | 94 |
| 11 | 20 | 6 | 131 | 18 | 970 | 230 | 4 | 3 | 13 | 61 | 13 | 128 | 60 | 346 | 247 | 583 | 617 | 10 | 10 | 32 | 177 | 74 | 44 | 75 |
| 11 | 20 | 6 | 483 | 376 | 512 | 688 | 15 | 15 | 47 | 329 | 155 | 84 | 81 | 468 | 375 | 546 | 654 | 16 | 16 | 38 | 287 | 129 | 110 | 96 |
| 11 | 21 | 6 | 103 | 352 | 147 | 1053 | 4 | 28 | 18 | 91 | 46 | 17 | 341 | 50 | 189 | 75 | 1125 | 1 | 16 | 10 | 39 | 27 | 2 | 91 |
| 11 | 21 | 6 | 104 | 235 | 161 | 1039 | 3 | 21 | 22 | 89 | 44 | 62 | 214 | 2 | 56 | 95 | 1105 | 0 | 0 | 4 | 2 | 2 | 0 | 0 |
| 11 | 21 | 6 | 133 | 435 | 168 | 1032 | 4 | 30 | 20 | 109 | 50 | 33 | 216 | 120 | 410 | 123 | 1077 | 5 | 29 | 17 | 90 | 35 | 11 | 210 |
| 11 | 21 | 6 | 152 | 678 | 95 | 1105 | 3 | 32 | 14 | 113 | 36 | 16 | 233 | 129 | 710 | 135 | 1065 | 3 | 33 | 20 | 108 | 45 | 15 | 138 |
| 11 | 21 | 6 | 134 | 630 | 121 | 1079 | 3 | 36 | 17 | 110 | 38 | 19 | 188 | 156 | 562 | 128 | 1072 | 4 | 25 | 19 | 119 | 43 | 18 | 107 |
| 11 | 22 | 6 | 744 | 146 | 1013 | 187 | 32 | 4 | 26 | 159 | 73 | 165 | 12 | 729 | 171 | 1001 | 199 | 34 | 2 | 28 | 161 | 75 | 188 | 10 |
| 11 | 22 | 6 | 797 | 163 | 991 | 209 | 34 | 3 | 35 | 236 | 90 | 161 | 16 | 867 | 83 | 1060 | 140 | 34 | 4 | 23 | 138 | 50 | 206 | 27 |
| 11 | 22 | 6 | 821 | 124 | 1035 | 165 | 28 | 3 | 25 | 148 | 70 | 143 | 15 | 844 | 158 | 987 | 213 | 29 | 6 | 30 | 189 | 96 | 141 | 20 |

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| 11 | 22 | 6 | 705 | 77 | 1056 | 143 | 34 | 2 | 20 | 101 | 51 | 257 | 17 | 924 | 99 | 1046 | 154 | 22 | 4 | 25 | 138 | 73 | 135 | 40 |
| 11 | 22 | 6 | 932 | 84 | 1060 | 140 | 30 | 3 | 28 | 190 | 63 | 178 | 23 | 858 | 220 | 987 | 213 | 35 | 3 | 42 | 264 | 140 | 197 | 9 |
| 11 | 23 | 6 | 208 | 584 | 187 | 1013 | 7 | 27 | 19 | 160 | 52 | 29 | 198 | 209 | 520 | 232 | 968 | 6 | 24 | 23 | 146 | 59 | 43 | 273 |
| 11 | 23 | 6 | 141 | 487 | 140 | 1045 | 4 | 28 | 16 | 104 | 36 | 39 | 406 | 233 | 484 | 268 | 932 | 8 | 23 | 26 | 160 | 73 | 93 | 341 |
| 11 | 23 | 6 | 365 | 549 | 339 | 861 | 8 | 27 | 34 | 253 | 87 | 82 | 217 | 335 | 496 | 300 | 900 | 5 | 27 | 34 | 234 | 85 | 63 | 279 |
| 11 | 23 | 6 | 276 | 588 | 257 | 943 | 6 | 26 | 28 | 194 | 81 | 43 | 201 | 263 | 444 | 258 | 942 | 7 | 24 | 24 | 164 | 63 | 50 | 335 |
| 11 | 23 | 6 | 288 | 536 | 239 | 961 | 6 | 29 | 30 | 216 | 74 | 34 | 286 | 187 | 471 | 200 | 1000 | 7 | 24 | 20 | 130 | 49 | 58 | 317 |
| 11 | 24 | 6 | 691 | 138 | 769 | 431 | 26 | 5 | 38 | 221 | 76 | 173 | 27 | 888 | 234 | 868 | 332 | 28 | 8 | 44 | 274 | 129 | 84 | 51 |
| 11 | 24 | 6 | 906 | 289 | 805 | 395 | 25 | 6 | 48 | 309 | 152 | 88 | 27 | 792 | 312 | 796 | 404 | 26 | 8 | 40 | 287 | 137 | 130 | 37 |
| 11 | 24 | 6 | 973 | 373 | 746 | 454 | 30 | 7 | 49 | 397 | 151 | 102 | 50 | 1112 | 353 | 754 | 446 | 28 | 8 | 50 | 462 | 160 | 114 | 60 |
| 11 | 24 | 6 | 727 | 187 | 761 | 439 | 25 | 5 | 30 | 210 | 87 | 107 | 22 | 808 | 191 | 903 | 297 | 26 | 8 | 31 | 223 | 85 | 161 | 55 |
| 11 | 24 | 6 | 855 | 381 | 750 | 447 | 28 | 8 | 56 | 409 | 159 | 123 | 39 | 845 | 337 | 804 | 396 | 27 | 6 | 46 | 331 | 149 | 107 | 52 |
| 11 | 25 | 6 | 509 | 372 | 541 | 659 | 15 | 15 | 46 | 305 | 126 | 82 | 86 | 489 | 374 | 514 | 686 | 16 | 17 | 46 | 295 | 121 | 76 | 109 |
| 11 | 25 | 6 | 341 | 273 | 557 | 643 | 13 | 14 | 38 | 194 | 101 | 135 | 155 | 381 | 293 | 577 | 623 | 16 | 16 | 41 | 197 | 102 | 137 | 125 |
| 11 | 25 | 6 | 316 | 258 | 504 | 696 | 14 | 14 | 42 | 194 | 90 | 124 | 142 | 371 | 241 | 605 | 595 | 17 | 16 | 45 | 191 | 103 | 129 | 126 |
| 11 | 25 | 6 | 385 | 260 | 550 | 650 | 16 | 17 | 42 | 225 | 104 | 166 | 138 | 326 | 245 | 512 | 688 | 16 | 16 | 36 | 171 | 88 | 124 | 136 |
| 11 | 25 | 6 | 507 | 296 | 593 | 607 | 16 | 17 | 40 | 265 | 115 | 133 | 137 | 423 | 340 | 524 | 676 | 18 | 17 | 39 | 249 | 106 | 125 | 126 |
| 12 | 20 | 6 | 276 | 333 | 583 | 617 | 15 | 14 | 58 | 175 | 171 | 246 | 187 | 157 | 253 | 476 | 724 | 14 | 15 | 35 | 111 | 122 | 275 | 330 |
| 12 | 20 | 6 | 262 | 355 | 545 | 655 | 15 | 16 | 54 | 163 | 214 | 226 | 251 | 222 | 315 | 539 | 661 | 14 | 14 | 46 | 125 | 182 | 250 | 207 |
| 12 | 20 | 6 | 256 | 392 | 561 | 639 | 16 | 17 | 58 | 172 | 216 | 219 | 200 | 275 | 334 | 536 | 664 | 16 | 18 | 52 | 155 | 193 | 197 | 267 |
| 12 | 20 | 6 | 246 | 336 | 635 | 565 | 17 | 16 | 58 | 166 | 213 | 302 | 190 | 243 | 394 | 549 | 651 | 16 | 17 | 51 | 152 | 197 | 239 | 219 |
| 12 | 20 | 6 | 261 | 406 | 574 | 626 | 17 | 16 | 53 | 164 | 200 | 263 | 177 | 294 | 387 | 647 | 553 | 15 | 15 | 63 | 209 | 226 | 326 | 135 |
| 12 | 21 | 6 | 53 | 284 | 97 | 1103 | 3 | 26 | 20 | 42 | 61 | 33 | 269 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | 21 | 6 | 63 | 415 | 108 | 1091 | 3 | 32 | 26 | 49 | 87 | 31 | 383 | 0 | 36 | 0 | 1200 | 0 | 6 | 0 | 0 | 0 | 0 | 110 |
| 12 | 21 | 6 | 96 | 420 | 176 | 1024 | 4 | 33 | 32 | 67 | 109 | 63 | 316 | 41 | 155 | 849 | 351 | 2 | 10 | 11 | 32 | 39 | 26 | 121 |
| 12 | 21 | 6 | 123 | 403 | 230 | 970 | 5 | 33 | 32 | 91 | 113 | 78 | 304 | 54 | 126 | 87 | 1113 | 1 | 17 | 12 | 31 | 46 | 15 | 276 |
| 12 | 21 | 6 | 146 | 451 | 221 | 979 | 4 | 34 | 41 | 98 | 149 | 59 | 337 | 98 | 323 | 139 | 1061 | 3 | 27 | 23 | 67 | 94 | 33 | 258 |
| 12 | 22 | 6 | 246 | 148 | 947 | 253 | 32 | 4 | 35 | 118 | 83 | 400 | 75 | 89 | 72 | 1113 | 87 | 10 | 1 | 14 | 44 | 40 | 121 | 5 |
| 12 | 22 | 6 | 320 | 169 | 913 | 287 | 29 | 6 | 38 | 123 | 101 | 339 | 92 | 46 | 15 | 1185 | 15 | 9 | 0 | 4 | 12 | 12 | 114 | 0 |
| 12 | 22 | 6 | 314 | 175 | 930 | 270 | 31 | 5 | 44 | 131 | 122 | 278 | 58 | 98 | 37 | 1127 | 73 | 18 | 1 | 10 | 30 | 27 | 211 | 30 |
| 12 | 22 | 6 | 314 | 171 | 904 | 295 | 30 | 6 | 43 | 134 | 123 | 322 | 82 | 212 | 93 | 1030 | 170 | 30 | 3 | 25 | 76 | 60 | 347 | 54 |
| 12 | 22 | 6 | 386 | 205 | 916 | 284 | 33 | 3 | 51 | 167 | 130 | 251 | 50 | 101 | 39 | 1101 | 99 | 13 | 3 | 12 | 25 | 30 | 171 | 50 |
| 12 | 23 | 6 | 120 | 340 | 237 | 963 | 5 | 30 | 36 | 84 | 106 | 72 | 391 | 10 | 15 | 22 | 1178 | 1 | 1 | 2 | 7 | 3 | 10 | 3 |
| 12 | 23 | 6 | 196 | 364 | 303 | 897 | 7 | 30 | 42 | 132 | 122 | 91 | 279 | 32 | 54 | 67 | 1133 | 2 | 5 | 6 | 22 | 17 | 25 | 76 |
| 12 | 23 | 6 | 177 | 438 | 257 | 943 | 6 | 29 | 44 | 125 | 147 | 71 | 322 | 90 | 198 | 164 | 1036 | 4 | 14 | 20 | 65 | 64 | 60 | 160 |
| 12 | 23 | 6 | 204 | 408 | 358 | 842 | 9 | 27 | 48 | 145 | 158 | 132 | 283 | 136 | 295 | 231 | 969 | 5 | 28 | 38 | 84 | 123 | 58 | 365 |
| 12 | 23 | 6 | 192 | 446 | 278 | 922 | 5 | 32 | 47 | 150 | 171 | 75 | 364 | 148 | 324 | 309 | 891 | 9 | 27 | 38 | 99 | 110 | 104 | 290 |
| 12 | 24 | 6 | 371 | 255 | 851 | 349 | 29 | 7 | 63 | 185 | 152 | 249 | 51 | 256 | 137 | 974 | 226 | 24 | 7 | 38 | 99 | 98 | 354 | 57 |
| 12 | 24 | 6 | 344 | 195 | 900 | 300 | 30 | 7 | 57 | 148 | 118 | 251 | 57 | 214 | 133 | 991 | 209 | 20 | 5 | 34 | 81 | 79 | 185 | 38 |
| 12 | 24 | 6 | 358 | 181 | 929 | 271 | 27 | 5 | 60 | 158 | 125 | 225 | 37 | 213 | 112 | 1008 | 192 | 25 | 7 | 34 | 64 | 84 | 226 | 56 |
| 12 | 24 | 6 | 308 | 158 | 920 | 280 | 25 | 6 | 49 | 125 | 109 | 266 | 69 | 125 | 53 | 1121 | 79 | 10 | 2 | 14 | 36 | 33 | 93 | 12 |

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| 12 | 24 | 6 | 431 | 225 | 916 | 284 | 31 | 5 | 58 | 190 | 155 | 283 | 42 | 368 | 206 | 911 | 289 | 25 | 9 | 53 | 156 | 160 | 209 | 75 |
| 12 | 25 | 6 | 173 | 184 | 801 | 399 | 12 | 12 | 39 | 94 | 86 | 136 | 130 | 53 | 51 | 1100 | 100 | 4 | 3 | 10 | 27 | 29 | 46 | 36 |
| 12 | 25 | 6 | 253 | 269 | 654 | 546 | 19 | 18 | 50 | 130 | 126 | 215 | 158 | 48 | 45 | 1099 | 101 | 3 | 4 | 7 | 17 | 19 | 31 | 38 |
| 12 | 25 | 6 | 233 | 246 | 591 | 609 | 17 | 15 | 45 | 123 | 101 | 205 | 189 | 2 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12 | 25 | 6 | 250 | 272 | 590 | 610 | 19 | 18 | 53 | 135 | 118 | 192 | 177 | 33 | 32 | 1092 | 108 | 3 | 4 | 8 | 14 | 20 | 29 | 43 |
| 12 | 25 | 6 | 271 | 283 | 669 | 531 | 17 | 17 | 51 | 141 | 140 | 221 | 157 | 79 | 71 | 1072 | 128 | 3 | 4 | 12 | 35 | 38 | 32 | 41 |

# APPENDIX C

The raw data from the last five sessions from each condition of Experiment 3 are presented for each possum. Data is presented separately from the first and second half of the session. The subject (S, 2 = George; 3 = Arthur; 4 = Timmy; 5 = Holly; 6 = Sylvester; 7 = Maggie), condition (C), left responses (RL), right responses (RR), time allocated to the left (TL) and right levers (TR), the reinforcers obtained for responses to the left (RfL) and right levers (RfR), the number of changeovers (CO) the number of responses during the COD on the left (R>L) and right levers (L>R), and the post-reinforcement pause times on the following reinforcers for responses on the left (PTL) and right levers (PTR), are presented.

| | | First half | | | | | | | | | | | Second half | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | C | RL | RR | TL | TR | RfL | RfR | CO | R>L | L>R | PTL | PTR | RL | RR | TL | TR | RfL | RfR | CO | R>L | L>R | PTL | PTR |
| 2 | 1 | 268 | 168 | 613 | 575 | 17 | 16 | 81 | 168 | 63 | 163 | 249 | 224 | 148 | 593 | 607 | 16 | 17 | 72 | 130 | 61 | 158 | 305 |
| 2 | 1 | 79 | 59 | 947 | 208 | 6 | 4 | 23 | 53 | 20 | 786 | 62 | 21 | 9 | 687 | 513 | 1 | 1 | 7 | 15 | 4 | 654 | 11 |
| 2 | 1 | 161 | 107 | 614 | 568 | 17 | 15 | 55 | 95 | 52 | 196 | 361 | 189 | 116 | 598 | 602 | 16 | 16 | 61 | 116 | 47 | 173 | 332 |
| 2 | 1 | 221 | 144 | 422 | 777 | 14 | 13 | 66 | 149 | 52 | 83 | 175 | 224 | 112 | 597 | 603 | 18 | 18 | 63 | 139 | 46 | 130 | 251 |
| 2 | 1 | 271 | 154 | 596 | 600 | 18 | 18 | 79 | 157 | 62 | 124 | 256 | 243 | 134 | 651 | 549 | 19 | 16 | 71 | 145 | 59 | 113 | 279 |
| 2 | 2 | 285 | 209 | 624 | 574 | 19 | 18 | 101 | 175 | 83 | 152 | 144 | 216 | 138 | 704 | 496 | 19 | 19 | 72 | 113 | 48 | 199 | 197 |
| 2 | 2 | 321 | 225 | 626 | 556 | 21 | 20 | 103 | 173 | 78 | 161 | 122 | 332 | 186 | 673 | 527 | 20 | 19 | 90 | 171 | 67 | 173 | 137 |
| 2 | 2 | 274 | 190 | 598 | 591 | 20 | 21 | 86 | 135 | 70 | 128 | 176 | 304 | 201 | 577 | 623 | 19 | 20 | 95 | 181 | 71 | 122 | 180 |
| 2 | 2 | 360 | 252 | 589 | 608 | 22 | 20 | 105 | 198 | 88 | 127 | 117 | 299 | 206 | 636 | 564 | 19 | 20 | 98 | 154 | 82 | 137 | 133 |
| 2 | 2 | 346 | 264 | 565 | 630 | 19 | 21 | 107 | 202 | 90 | 97 | 124 | 254 | 146 | 761 | 439 | 19 | 18 | 72 | 120 | 51 | 117 | 142 |
| 2 | 3 | 313 | 183 | 627 | 571 | 19 | 19 | 88 | 198 | 73 | 103 | 223 | 263 | 139 | 690 | 510 | 19 | 18 | 70 | 127 | 53 | 186 | 209 |
| 2 | 3 | 257 | 133 | 649 | 524 | 17 | 18 | 68 | 147 | 57 | 136 | 214 | 230 | 130 | 689 | 511 | 19 | 18 | 64 | 108 | 51 | 155 | 219 |
| 2 | 3 | 278 | 143 | 679 | 516 | 19 | 19 | 74 | 169 | 61 | 149 | 211 | 237 | 128 | 649 | 551 | 19 | 19 | 59 | 113 | 46 | 180 | 266 |
| 2 | 3 | 305 | 153 | 670 | 513 | 19 | 18 | 83 | 172 | 65 | 170 | 192 | 232 | 132 | 669 | 531 | 17 | 17 | 65 | 114 | 57 | 184 | 229 |
| 2 | 3 | 375 | 189 | 656 | 535 | 18 | 18 | 89 | 232 | 71 | 119 | 140 | 259 | 141 | 689 | 511 | 19 | 18 | 70 | 120 | 60 | 182 | 213 |
| 2 | 4 | 203 | 167 | 300 | 894 | 17 | 20 | 70 | 145 | 47 | 85 | 304 | 116 | 126 | 285 | 915 | 14 | 13 | 52 | 82 | 29 | 121 | 239 |
| 2 | 4 | 168 | 160 | 280 | 898 | 18 | 17 | 64 | 119 | 40 | 87 | 313 | 40 | 67 | 103 | 1097 | 7 | 6 | 22 | 26 | 14 | 37 | 121 |
| 2 | 4 | 135 | 100 | 400 | 795 | 14 | 14 | 57 | 90 | 34 | 191 | 271 | 42 | 32 | 596 | 604 | 4 | 4 | 19 | 30 | 11 | 232 | 45 |
| 2 | 4 | 179 | 138 | 301 | 892 | 16 | 16 | 61 | 128 | 36 | 118 | 272 | 7 | 18 | 55 | 1145 | 1 | 0 | 5 | 6 | 3 | 31 | 0 |
| 2 | 4 | 147 | 136 | 256 | 704 | 14 | 14 | 60 | 106 | 46 | 79 | 211 | 46 | 72 | 534 | 666 | 8 | 6 | 25 | 38 | 14 | 471 | 173 |
| 2 | 5 | 402 | 103 | 868 | 323 | 16 | 17 | 77 | 136 | 56 | 205 | 83 | 311 | 68 | 968 | 232 | 16 | 15 | 51 | 83 | 38 | 275 | 70 |
| 2 | 5 | 449 | 122 | 881 | 313 | 18 | 19 | 84 | 176 | 64 | 219 | 61 | 450 | 83 | 961 | 239 | 15 | 15 | 76 | 128 | 49 | 153 | 54 |
| 2 | 5 | 421 | 99 | 887 | 304 | 16 | 18 | 77 | 143 | 57 | 232 | 100 | 437 | 86 | 965 | 235 | 15 | 14 | 66 | 142 | 46 | 193 | 59 |
| 2 | 5 | 305 | 79 | 931 | 263 | 17 | 16 | 56 | 112 | 47 | 245 | 86 | 158 | 29 | 1115 | 85 | 6 | 6 | 23 | 48 | 17 | 72 | 21 |
| 2 | 5 | 346 | 109 | 846 | 328 | 16 | 18 | 69 | 115 | 53 | 267 | 88 | 292 | 67 | 992 | 208 | 15 | 15 | 52 | 70 | 36 | 294 | 60 |
| 3 | 1 | 240 | 213 | 694 | 506 | 18 | 17 | 55 | 77 | 78 | 246 | 194 | 153 | 146 | 755 | 445 | 15 | 15 | 35 | 43 | 55 | 410 | 210 |
| 3 | 1 | 144 | 178 | 673 | 527 | 16 | 15 | 39 | 56 | 59 | 391 | 284 | 143 | 158 | 726 | 474 | 15 | 16 | 39 | 55 | 57 | 425 | 242 |

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| 3 | 1 | 144 | 186 | 648 | 551 | 17 | 17 | 44 | 65 | 63 | 319 | 293 | 154 | 275 | 465 | 735 | 16 | 16 | 52 | 69 | 81 | 157 | 337 |
| 3 | 1 | 177 | 191 | 672 | 526 | 16 | 16 | 45 | 64 | 75 | 302 | 266 | 170 | 164 | 689 | 511 | 15 | 15 | 40 | 56 | 57 | 347 | 282 |
| 3 | 1 | 209 | 229 | 643 | 556 | 20 | 19 | 57 | 76 | 90 | 258 | 258 | 172 | 156 | 704 | 496 | 17 | 18 | 40 | 60 | 65 | 356 | 287 |
| 3 | 2 | 276 | 321 | 531 | 667 | 18 | 20 | 73 | 139 | 136 | 165 | 160 | 201 | 216 | 624 | 576 | 17 | 16 | 53 | 95 | 103 | 238 | 131 |
| 3 | 2 | 232 | 282 | 543 | 656 | 18 | 18 | 64 | 117 | 108 | 195 | 145 | 219 | 246 | 565 | 635 | 16 | 17 | 58 | 96 | 103 | 173 | 139 |
| 3 | 2 | 335 | 377 | 553 | 644 | 20 | 22 | 89 | 168 | 168 | 169 | 111 | 247 | 255 | 579 | 621 | 20 | 18 | 65 | 113 | 129 | 176 | 129 |
| 3 | 2 | 333 | 293 | 639 | 560 | 22 | 19 | 75 | 136 | 137 | 209 | 102 | 226 | 199 | 645 | 555 | 18 | 19 | 55 | 91 | 102 | 256 | 147 |
| 3 | 2 | 328 | 332 | 573 | 625 | 19 | 21 | 76 | 147 | 147 | 168 | 160 | 261 | 297 | 609 | 591 | 16 | 17 | 70 | 123 | 155 | 159 | 113 |
| 3 | 3 | 221 | 292 | 472 | 726 | 19 | 21 | 70 | 101 | 128 | 120 | 348 | 213 | 267 | 483 | 717 | 18 | 19 | 62 | 96 | 103 | 112 | 396 |
| 3 | 3 | 343 | 307 | 618 | 578 | 20 | 21 | 82 | 135 | 144 | 116 | 165 | 230 | 226 | 708 | 492 | 19 | 17 | 60 | 86 | 96 | 191 | 188 |
| 3 | 3 | 259 | 258 | 576 | 594 | 19 | 19 | 71 | 120 | 125 | 114 | 230 | 220 | 200 | 657 | 543 | 19 | 18 | 57 | 89 | 105 | 126 | 257 |
| 3 | 3 | 258 | 250 | 630 | 568 | 19 | 19 | 62 | 102 | 97 | 183 | 197 | 223 | 225 | 663 | 537 | 18 | 19 | 56 | 90 | 101 | 123 | 217 |
| 3 | 3 | 319 | 303 | 632 | 566 | 19 | 20 | 79 | 136 | 142 | 139 | 176 | 197 | 218 | 639 | 561 | 19 | 19 | 57 | 84 | 84 | 157 | 216 |
| 3 | 4 | 250 | 250 | 567 | 633 | 20 | 18 | 69 | 114 | 97 | 189 | 263 | 182 | 188 | 588 | 612 | 18 | 18 | 52 | 84 | 79 | 228 | 305 |
| 3 | 4 | 265 | 293 | 548 | 644 | 19 | 20 | 74 | 129 | 105 | 128 | 194 | 212 | 258 | 597 | 603 | 18 | 19 | 65 | 104 | 103 | 140 | 206 |
| 3 | 4 | 297 | 367 | 532 | 657 | 20 | 21 | 82 | 152 | 143 | 138 | 183 | 243 | 255 | 606 | 594 | 20 | 19 | 72 | 121 | 98 | 176 | 209 |
| 3 | 4 | 208 | 262 | 485 | 688 | 18 | 18 | 65 | 97 | 94 | 146 | 229 | 215 | 253 | 559 | 641 | 18 | 17 | 63 | 90 | 84 | 142 | 186 |
| 3 | 4 | 185 | 213 | 434 | 761 | 18 | 18 | 62 | 98 | 79 | 108 | 273 | 164 | 177 | 473 | 727 | 17 | 17 | 49 | 75 | 52 | 154 | 348 |
| 3 | 5 | 203 | 52 | 879 | 204 | 8 | 10 | 31 | 52 | 28 | 184 | 33 | 161 | 18 | 1144 | 56 | 8 | 5 | 12 | 20 | 10 | 158 | 16 |
| 3 | 5 | 347 | 56 | 1062 | 128 | 11 | 11 | 34 | 59 | 32 | 195 | 26 | 334 | 39 | 1101 | 99 | 8 | 7 | 28 | 41 | 21 | 134 | 22 |
| 3 | 5 | 327 | 70 | 1055 | 131 | 10 | 9 | 41 | 76 | 49 | 179 | 31 | 282 | 57 | 1029 | 171 | 11 | 12 | 35 | 69 | 29 | 244 | 55 |
| 3 | 5 | 276 | 66 | 966 | 176 | 13 | 13 | 42 | 72 | 37 | 217 | 56 | 223 | 32 | 1053 | 147 | 9 | 7 | 24 | 30 | 20 | 178 | 26 |
| 3 | 5 | 294 | 75 | 1010 | 175 | 15 | 14 | 32 | 59 | 40 | 308 | 54 | 297 | 68 | 1038 | 162 | 12 | 13 | 30 | 42 | 40 | 251 | 53 |
| 4 | 1 | 188 | 200 | 716 | 482 | 16 | 16 | 60 | 92 | 131 | 398 | 277 | 199 | 138 | 775 | 425 | 16 | 15 | 49 | 78 | 105 | 453 | 288 |
| 4 | 1 | 84 | 96 | 344 | 848 | 7 | 9 | 30 | 35 | 65 | 182 | 744 | 3 | 9 | 29 | 1171 | 1 | 1 | 2 | 1 | 6 | 21 | 1151 |
| 4 | 1 | 207 | 161 | 695 | 503 | 15 | 15 | 44 | 76 | 102 | 414 | 337 | 225 | 147 | 782 | 418 | 15 | 15 | 51 | 75 | 108 | 431 | 274 |
| 4 | 1 | 158 | 138 | 719 | 467 | 17 | 15 | 47 | 59 | 97 | 447 | 332 | 161 | 125 | 715 | 485 | 15 | 16 | 40 | 55 | 83 | 468 | 335 |
| 4 | 1 | 170 | 143 | 694 | 500 | 16 | 17 | 51 | 78 | 93 | 425 | 326 | 215 | 223 | 668 | 532 | 15 | 16 | 63 | 93 | 141 | 381 | 331 |
| 4 | 2 | 241 | 301 | 649 | 526 | 17 | 17 | 69 | 131 | 184 | 422 | 178 | 181 | 240 | 675 | 525 | 17 | 16 | 56 | 101 | 147 | 494 | 220 |
| 4 | 2 | 267 | 338 | 647 | 544 | 17 | 18 | 81 | 145 | 195 | 406 | 198 | 180 | 187 | 711 | 489 | 18 | 16 | 55 | 88 | 111 | 465 | 167 |
| 4 | 2 | 199 | 239 | 590 | 608 | 19 | 17 | 59 | 122 | 136 | 384 | 215 | 217 | 276 | 580 | 620 | 16 | 17 | 72 | 129 | 178 | 338 | 221 |
| 4 | 2 | 260 | 350 | 585 | 610 | 16 | 17 | 82 | 145 | 214 | 320 | 174 | 160 | 200 | 574 | 626 | 15 | 16 | 60 | 89 | 128 | 380 | 200 |
| 4 | 2 | 243 | 277 | 614 | 585 | 19 | 17 | 71 | 135 | 175 | 353 | 172 | 195 | 239 | 563 | 637 | 16 | 16 | 66 | 116 | 163 | 344 | 233 |
| 4 | 3 | 317 | 212 | 689 | 501 | 16 | 15 | 64 | 102 | 133 | 278 | 301 | 202 | 181 | 623 | 577 | 16 | 16 | 55 | 76 | 95 | 286 | 348 |
| 4 | 3 | 257 | 239 | 599 | 598 | 17 | 16 | 66 | 110 | 149 | 243 | 386 | 189 | 174 | 675 | 525 | 18 | 19 | 52 | 85 | 115 | 378 | 358 |
| 4 | 3 | 265 | 230 | 633 | 555 | 16 | 16 | 68 | 130 | 131 | 227 | 350 | 219 | 182 | 624 | 576 | 15 | 16 | 60 | 96 | 120 | 260 | 381 |
| 4 | 3 | 275 | 228 | 684 | 504 | 17 | 17 | 72 | 115 | 153 | 272 | 284 | 284 | 223 | 598 | 602 | 18 | 19 | 63 | 123 | 128 | 213 | 353 |
| 4 | 3 | 274 | 238 | 640 | 555 | 18 | 16 | 72 | 125 | 159 | 249 | 337 | 189 | 181 | 594 | 606 | 14 | 15 | 60 | 83 | 120 | 259 | 382 |
| 4 | 4 | 200 | 285 | 482 | 718 | 17 | 18 | 75 | 125 | 160 | 217 | 403 | 214 | 321 | 485 | 715 | 18 | 17 | 77 | 137 | 178 | 262 | 392 |
| 4 | 4 | 189 | 276 | 433 | 759 | 17 | 17 | 66 | 105 | 146 | 218 | 404 | 272 | 322 | 470 | 730 | 17 | 19 | 89 | 153 | 200 | 220 | 381 |
| 4 | 4 | 242 | 328 | 426 | 770 | 16 | 16 | 84 | 161 | 176 | 228 | 365 | 249 | 284 | 494 | 706 | 19 | 17 | 78 | 153 | 169 | 294 | 385 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4 | 203 | 247 | 408 | 726 | 17 | 16 | 67 | 131 | 150 | 237 | 405 | 211 | 270 | 483 | 717 | 17 | 18 | 72 | 129 | 175 | 266 | 382 |
| 4 | 4 | 134 | 195 | 363 | 815 | 15 | 15 | 52 | 75 | 111 | 196 | 359 | 35 | 62 | 672 | 528 | 6 | 5 | 13 | 17 | 34 | 626 | 135 |
| 4 | 5 | 267 | 225 | 805 | 377 | 15 | 15 | 70 | 112 | 166 | 425 | 190 | 305 | 265 | 864 | 336 | 17 | 16 | 78 | 128 | 187 | 489 | 161 |
| 4 | 5 | 270 | 191 | 899 | 294 | 18 | 16 | 58 | 84 | 141 | 431 | 160 | 281 | 193 | 886 | 314 | 15 | 17 | 53 | 83 | 131 | 452 | 177 |
| 4 | 5 | 282 | 167 | 915 | 272 | 15 | 16 | 55 | 82 | 122 | 487 | 138 | 274 | 150 | 923 | 277 | 13 | 13 | 61 | 95 | 112 | 509 | 145 |
| 4 | 5 | 299 | 228 | 852 | 332 | 15 | 15 | 65 | 124 | 147 | 416 | 129 | 248 | 193 | 869 | 331 | 14 | 14 | 58 | 107 | 131 | 498 | 175 |
| 4 | 5 | 269 | 168 | 874 | 306 | 15 | 15 | 58 | 90 | 110 | 416 | 151 | 222 | 129 | 943 | 257 | 15 | 15 | 46 | 63 | 90 | 400 | 144 |
| 5 | 1 | 157 | 108 | 625 | 570 | 11 | 13 | 37 | 59 | 64 | 351 | 368 | 104 | 61 | 938 | 262 | 11 | 6 | 23 | 42 | 32 | 455 | 180 |
| 5 | 1 | 132 | 125 | 682 | 504 | 14 | 14 | 41 | 61 | 72 | 431 | 357 | 59 | 50 | 674 | 526 | 10 | 8 | 17 | 28 | 23 | 373 | 285 |
| 5 | 1 | 129 | 132 | 626 | 501 | 14 | 15 | 37 | 57 | 64 | 413 | 299 | 111 | 106 | 674 | 526 | 12 | 12 | 29 | 47 | 45 | 456 | 326 |
| 5 | 1 | 147 | 146 | 635 | 565 | 14 | 14 | 48 | 81 | 80 | 419 | 317 | 115 | 91 | 611 | 589 | 14 | 15 | 30 | 64 | 42 | 464 | 457 |
| 5 | 1 | 119 | 79 | 670 | 458 | 11 | 12 | 35 | 53 | 56 | 311 | 316 | 116 | 75 | 618 | 582 | 11 | 9 | 30 | 48 | 39 | 303 | 435 |
| 5 | 2 | 190 | 212 | 633 | 549 | 15 | 17 | 57 | 94 | 86 | 306 | 190 | 138 | 197 | 575 | 625 | 12 | 12 | 44 | 76 | 72 | 396 | 146 |
| 5 | 2 | 197 | 219 | 665 | 519 | 16 | 17 | 54 | 96 | 106 | 406 | 181 | 155 | 118 | 691 | 509 | 15 | 15 | 40 | 75 | 56 | 502 | 275 |
| 5 | 2 | 215 | 210 | 703 | 489 | 16 | 18 | 50 | 95 | 83 | 417 | 149 | 161 | 155 | 731 | 469 | 17 | 17 | 44 | 73 | 66 | 519 | 191 |
| 5 | 2 | 279 | 253 | 733 | 465 | 16 | 16 | 64 | 105 | 107 | 387 | 155 | 199 | 151 | 701 | 499 | 15 | 14 | 50 | 76 | 72 | 420 | 171 |
| 5 | 2 | 167 | 231 | 670 | 524 | 15 | 16 | 47 | 78 | 75 | 439 | 231 | 149 | 127 | 793 | 407 | 17 | 15 | 37 | 64 | 48 | 585 | 182 |
| 5 | 3 | 269 | 246 | 580 | 608 | 17 | 20 | 66 | 120 | 122 | 158 | 339 | 210 | 156 | 506 | 694 | 16 | 16 | 50 | 109 | 67 | 251 | 465 |
| 5 | 3 | 265 | 193 | 618 | 579 | 19 | 19 | 55 | 109 | 88 | 234 | 329 | 218 | 120 | 577 | 623 | 16 | 15 | 47 | 93 | 59 | 298 | 424 |
| 5 | 3 | 166 | 132 | 542 | 641 | 16 | 17 | 43 | 81 | 68 | 271 | 483 | 146 | 92 | 562 | 638 | 15 | 15 | 34 | 63 | 44 | 341 | 480 |
| 5 | 3 | 254 | 162 | 607 | 581 | 17 | 18 | 52 | 105 | 77 | 213 | 348 | 150 | 95 | 759 | 441 | 14 | 12 | 34 | 61 | 42 | 535 | 292 |
| 5 | 3 | 195 | 122 | 653 | 546 | 15 | 16 | 39 | 69 | 66 | 347 | 401 | 124 | 91 | 645 | 555 | 13 | 12 | 33 | 57 | 49 | 445 | 426 |
| 5 | 4 | 159 | 241 | 423 | 776 | 16 | 16 | 53 | 98 | 83 | 203 | 448 | 68 | 127 | 576 | 624 | 10 | 10 | 23 | 49 | 30 | 494 | 364 |
| 5 | 4 | 229 | 246 | 514 | 683 | 16 | 17 | 67 | 120 | 111 | 224 | 338 | 124 | 122 | 638 | 562 | 13 | 11 | 31 | 66 | 42 | 151 | 342 |
| 5 | 4 | 145 | 174 | 470 | 707 | 15 | 15 | 47 | 86 | 64 | 280 | 364 | 83 | 171 | 463 | 737 | 13 | 12 | 30 | 63 | 45 | 343 | 384 |
| 5 | 4 | 141 | 217 | 357 | 786 | 15 | 15 | 44 | 83 | 66 | 176 | 348 | 33 | 71 | 824 | 376 | 5 | 3 | 14 | 25 | 15 | 788 | 124 |
| 5 | 4 | 187 | 230 | 404 | 764 | 15 | 15 | 60 | 106 | 84 | 165 | 374 | 66 | 104 | 699 | 501 | 7 | 7 | 30 | 47 | 39 | 245 | 227 |
| 5 | 5 | 346 | 159 | 878 | 313 | 16 | 17 | 56 | 91 | 97 | 448 | 143 | 177 | 87 | 772 | 428 | 13 | 12 | 36 | 52 | 54 | 484 | 208 |
| 5 | 5 | 230 | 111 | 866 | 327 | 14 | 13 | 46 | 71 | 64 | 499 | 195 | 170 | 76 | 972 | 228 | 12 | 12 | 34 | 49 | 46 | 471 | 127 |
| 5 | 5 | 249 | 147 | 877 | 316 | 14 | 14 | 54 | 75 | 83 | 429 | 164 | 153 | 54 | 1048 | 152 | 8 | 7 | 26 | 27 | 34 | 254 | 77 |
| 5 | 5 | 252 | 100 | 881 | 243 | 14 | 13 | 44 | 57 | 65 | 411 | 120 | 131 | 56 | 983 | 217 | 8 | 9 | 26 | 39 | 34 | 269 | 137 |
| 5 | 5 | 238 | 129 | 890 | 301 | 15 | 14 | 50 | 75 | 66 | 476 | 151 | 221 | 94 | 873 | 327 | 11 | 12 | 40 | 68 | 55 | 471 | 214 |
| 6 | 1 | 626 | 490 | 539 | 660 | 21 | 20 | 106 | 421 | 228 | 213 | 204 | 475 | 314 | 515 | 685 | 18 | 18 | 78 | 322 | 161 | 277 | 279 |
| 6 | 1 | 719 | 456 | 602 | 596 | 18 | 18 | 113 | 459 | 223 | 199 | 173 | 406 | 308 | 542 | 658 | 19 | 18 | 75 | 268 | 137 | 258 | 192 |
| 6 | 1 | 639 | 462 | 601 | 599 | 20 | 18 | 110 | 419 | 224 | 263 | 226 | 417 | 329 | 496 | 704 | 16 | 17 | 70 | 264 | 146 | 263 | 250 |
| 6 | 1 | 531 | 412 | 533 | 666 | 18 | 20 | 94 | 347 | 192 | 246 | 226 | 340 | 262 | 520 | 680 | 19 | 18 | 56 | 221 | 115 | 309 | 289 |
| 6 | 1 | 409 | 330 | 557 | 639 | 20 | 21 | 73 | 255 | 157 | 295 | 293 | 328 | 240 | 534 | 666 | 18 | 17 | 60 | 204 | 106 | 296 | 331 |
| 6 | 2 | 820 | 412 | 659 | 540 | 19 | 21 | 125 | 447 | 235 | 224 | 88 | 668 | 376 | 681 | 519 | 21 | 19 | 102 | 405 | 194 | 322 | 78 |
| 6 | 2 | 821 | 466 | 681 | 515 | 22 | 21 | 129 | 497 | 257 | 262 | 79 | 517 | 345 | 629 | 571 | 20 | 21 | 88 | 326 | 168 | 361 | 138 |
| 6 | 2 | 733 | 363 | 702 | 498 | 21 | 20 | 111 | 420 | 203 | 307 | 76 | 259 | 109 | 770 | 430 | 9 | 10 | 35 | 125 | 54 | 187 | 65 |
| 6 | 2 | 628 | 333 | 753 | 447 | 18 | 18 | 89 | 320 | 175 | 322 | 147 | 211 | 124 | 711 | 489 | 9 | 10 | 35 | 122 | 67 | 169 | 130 |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 2 | 705 | 360 | 699 | 501 | 19 | 21 | 100 | 408 | 190 | 317 | 117 | 314 | 213 | 396 | 804 | 14 | 14 | 51 | 189 | 89 | 213 | 384 |
| 6 | 3 | 572 | 472 | 447 | 753 | 20 | 21 | 103 | 364 | 174 | 76 | 200 | 396 | 300 | 416 | 784 | 17 | 19 | 75 | 273 | 104 | 107 | 340 |
| 6 | 3 | 659 | 459 | 466 | 726 | 22 | 19 | 109 | 443 | 165 | 112 | 232 | 456 | 269 | 440 | 760 | 17 | 18 | 77 | 304 | 114 | 98 | 319 |
| 6 | 3 | 522 | 335 | 498 | 699 | 18 | 20 | 102 | 341 | 144 | 98 | 238 | 303 | 136 | 682 | 518 | 12 | 10 | 51 | 193 | 59 | 64 | 193 |
| 6 | 3 | 529 | 305 | 484 | 710 | 21 | 18 | 89 | 356 | 130 | 101 | 251 | 298 | 212 | 642 | 558 | 13 | 14 | 50 | 178 | 79 | 47 | 228 |
| 6 | 3 | 651 | 408 | 494 | 700 | 19 | 19 | 105 | 391 | 137 | 93 | 259 | 373 | 211 | 475 | 725 | 14 | 15 | 61 | 226 | 90 | 112 | 298 |
| 6 | 4 | 325 | 656 | 313 | 884 | 18 | 16 | 67 | 247 | 97 | 134 | 207 | 112 | 407 | 136 | 1064 | 8 | 12 | 27 | 82 | 40 | 65 | 202 |
| 6 | 4 | 240 | 363 | 352 | 835 | 14 | 14 | 51 | 179 | 75 | 205 | 253 | 76 | 142 | 184 | 1016 | 6 | 6 | 18 | 60 | 25 | 134 | 112 |
| 6 | 4 | 95 | 182 | 118 | 1069 | 5 | 8 | 21 | 74 | 31 | 54 | 153 | 24 | 52 | 23 | 1177 | 1 | 0 | 8 | 19 | 10 | 10 | 0 |
| 6 | 4 | 162 | 343 | 188 | 994 | 11 | 13 | 38 | 128 | 52 | 84 | 194 | 2 | 2 | 317 | 883 | 0 | 0 | 1 | 2 | 0 | 0 | 842 |
| 6 | 4 | 137 | 314 | 166 | 1020 | 10 | 9 | 30 | 107 | 49 | 92 | 179 | 0 | 6 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 5 | 854 | 141 | 1018 | 173 | 14 | 12 | 70 | 253 | 95 | 236 | 50 | 502 | 78 | 817 | 383 | 7 | 7 | 35 | 127 | 52 | 152 | 26 |
| 6 | 5 | 909 | 119 | 1028 | 167 | 12 | 11 | 61 | 227 | 84 | 221 | 29 | 251 | 28 | 1154 | 46 | 3 | 3 | 13 | 46 | 20 | 44 | 15 |
| 6 | 5 | 773 | 123 | 981 | 203 | 15 | 14 | 68 | 249 | 79 | 279 | 68 | 158 | 14 | 806 | 394 | 1 | 2 | 10 | 29 | 12 | 21 | 7 |
| 6 | 5 | 924 | 120 | 1016 | 176 | 15 | 14 | 76 | 280 | 91 | 271 | 57 | 531 | 51 | 1067 | 133 | 6 | 6 | 29 | 100 | 41 | 96 | 22 |
| 6 | 5 | 1067 | 113 | 1021 | 175 | 12 | 12 | 60 | 207 | 72 | 183 | 49 | 513 | 49 | 1097 | 103 | 11 | 10 | 28 | 102 | 38 | 222 | 41 |

# APPENDIX D

The raw data from the last five sessions from each condition of Experiment 4 are presented for each possum. Data is presented separately from the first and second half of the session. The subject (S, 2 = George; 3 = Arthur; 4 = Timmy; 5 = Holly; 6 = Sylvester; 7 = Maggie), condition (C), left responses (RL), right responses (RR), time allocated to the left (TL) and right levers (TR), the reinforcers obtained for responses to the left (RfL) and right levers (RfR), the number of changeovers (CO) the number of responses during the COD on the left (R>L) and right levers (L>R), and the post-reinforcement pause times on the following reinforcers for responses on the left (PTL) and right levers (PTR), are presented.

| | | | First half | | | | | | | | | | | Second half | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S | C | % | RL | RR | TL | TR | RfL | RfR | CO | R>L | L>R | PTL | PTR | RL | RR | TL | TR | RfL | RfR | CO | R>L | L>R | PTL | PTR |
| 2 | 1 | 0 | 236 | 118 | 620 | 569 | 17 | 17 | 66 | 102 | 61 | 192 | 220 | 223 | 99 | 642 | 558 | 16 | 17 | 53 | 92 | 42 | 197 | 235 |
| 2 | 1 | 0 | 304 | 135 | 649 | 544 | 20 | 19 | 72 | 131 | 59 | 156 | 233 | 216 | 87 | 777 | 423 | 17 | 16 | 44 | 80 | 38 | 289 | 172 |
| 2 | 1 | 0 | 289 | 144 | 628 | 562 | 18 | 18 | 74 | 136 | 64 | 136 | 222 | 161 | 73 | 702 | 498 | 16 | 17 | 42 | 65 | 34 | 299 | 252 |
| 2 | 1 | 0 | 284 | 136 | 678 | 516 | 19 | 18 | 72 | 131 | 65 | 161 | 222 | 198 | 84 | 744 | 456 | 16 | 16 | 48 | 74 | 43 | 269 | 236 |
| 2 | 1 | 0 | 305 | 179 | 625 | 569 | 18 | 19 | 87 | 152 | 83 | 123 | 200 | 241 | 98 | 741 | 459 | 16 | 16 | 61 | 105 | 42 | 159 | 195 |
| 2 | 2 | 0 | 246 | 152 | 583 | 596 | 20 | 18 | 78 | 99 | 63 | 142 | 217 | 215 | 125 | 603 | 597 | 18 | 18 | 65 | 87 | 47 | 124 | 217 |
| 2 | 2 | 0 | 247 | 165 | 582 | 613 | 17 | 19 | 84 | 111 | 70 | 113 | 207 | 251 | 119 | 660 | 540 | 18 | 18 | 70 | 110 | 53 | 153 | 257 |
| 2 | 2 | 0 | 162 | 107 | 499 | 684 | 15 | 17 | 60 | 71 | 41 | 104 | 253 | 159 | 105 | 598 | 602 | 18 | 16 | 54 | 71 | 37 | 111 | 227 |
| 2 | 2 | 0 | 205 | 122 | 546 | 642 | 17 | 19 | 69 | 97 | 46 | 152 | 253 | 196 | 105 | 621 | 579 | 17 | 17 | 57 | 78 | 39 | 157 | 211 |
| 2 | 2 | 0 | 208 | 128 | 585 | 605 | 20 | 19 | 70 | 102 | 50 | 133 | 226 | 251 | 122 | 670 | 530 | 18 | 18 | 70 | 105 | 44 | 159 | 218 |
| 2 | 4 | 2 | 328 | 138 | 617 | 569 | 18 | 20 | 87 | 161 | 68 | 124 | 191 | 233 | 118 | 607 | 593 | 18 | 17 | 61 | 114 | 44 | 197 | 189 |
| 2 | 4 | 2 | 265 | 126 | 681 | 508 | 18 | 17 | 69 | 117 | 48 | 211 | 194 | 207 | 102 | 693 | 507 | 15 | 15 | 52 | 89 | 40 | 278 | 198 |
| 2 | 4 | 2 | 411 | 167 | 690 | 490 | 20 | 18 | 96 | 179 | 80 | 110 | 115 | 262 | 115 | 719 | 481 | 19 | 17 | 63 | 126 | 45 | 162 | 173 |
| 2 | 4 | 2 | 307 | 167 | 641 | 536 | 20 | 18 | 83 | 155 | 67 | 105 | 170 | 301 | 136 | 629 | 571 | 18 | 21 | 76 | 141 | 56 | 120 | 180 |
| 2 | 4 | 2 | 306 | 179 | 653 | 536 | 20 | 19 | 90 | 150 | 76 | 112 | 131 | 265 | 141 | 661 | 539 | 19 | 20 | 64 | 131 | 51 | 190 | 175 |
| 2 | 6 | 2 | 231 | 138 | 669 | 521 | 15 | 15 | 58 | 103 | 45 | 117 | 145 | 288 | 134 | 760 | 440 | 20 | 18 | 62 | 97 | 48 | 158 | 127 |
| 2 | 6 | 2 | 258 | 148 | 588 | 581 | 19 | 20 | 67 | 120 | 55 | 139 | 185 | 252 | 148 | 567 | 633 | 20 | 19 | 67 | 116 | 55 | 124 | 255 |
| 2 | 6 | 2 | 284 | 161 | 610 | 546 | 18 | 17 | 61 | 97 | 54 | 113 | 148 | 279 | 185 | 573 | 627 | 18 | 20 | 83 | 120 | 61 | 100 | 161 |
| 2 | 6 | 2 | 246 | 113 | 767 | 422 | 18 | 18 | 59 | 109 | 47 | 226 | 157 | 196 | 92 | 608 | 592 | 16 | 16 | 46 | 81 | 27 | 198 | 348 |
| 2 | 6 | 2 | 252 | 143 | 707 | 485 | 16 | 15 | 68 | 123 | 55 | 86 | 113 | 193 | 108 | 744 | 456 | 15 | 15 | 51 | 86 | 39 | 159 | 194 |
| 2 | 7 | 4 | 309 | 168 | 619 | 560 | 19 | 19 | 79 | 139 | 62 | 115 | 144 | 229 | 139 | 544 | 656 | 16 | 17 | 56 | 97 | 44 | 131 | 184 |
| 2 | 7 | 4 | 331 | 197 | 592 | 597 | 21 | 20 | 89 | 167 | 77 | 103 | 158 | 239 | 127 | 743 | 457 | 17 | 18 | 56 | 108 | 49 | 198 | 171 |
| 2 | 7 | 4 | 250 | 162 | 575 | 617 | 18 | 20 | 78 | 126 | 54 | 123 | 218 | 152 | 76 | 865 | 335 | 12 | 11 | 41 | 72 | 24 | 76 | 108 |
| 2 | 7 | 4 | 301 | 164 | 591 | 601 | 19 | 18 | 82 | 144 | 57 | 99 | 161 | 218 | 100 | 558 | 642 | 16 | 19 | 54 | 104 | 33 | 115 | 311 |
| 2 | 7 | 4 | 291 | 175 | 580 | 602 | 18 | 21 | 75 | 135 | 62 | 73 | 201 | 239 | 119 | 675 | 525 | 18 | 19 | 54 | 115 | 37 | 128 | 196 |
| 2 | 8 | 4 | 156 | 125 | 518 | 663 | 17 | 17 | 54 | 70 | 32 | 190 | 205 | 172 | 125 | 510 | 690 | 19 | 20 | 56 | 74 | 36 | 144 | 205 |
| 2 | 8 | 4 | 18 | 17 | 77 | 77 | 2 | 2 | 7 | 8 | 5 | 6 | 21 | 100 | 94 | 323 | 877 | 12 | 11 | 36 | 51 | 20 | 122 | 111 |
| 2 | 8 | 4 | 136 | 132 | 492 | 696 | 16 | 15 | 52 | 73 | 30 | 77 | 180 | 177 | 159 | 570 | 630 | 16 | 18 | 63 | 94 | 42 | 87 | 188 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 8 | 4 | 62 | 59 | 480 | 347 | 7 | 5 | 26 | 36 | 19 | 348 | 54 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 8 | 4 | 73 | 60 | 465 | 532 | 10 | 11 | 25 | 37 | 20 | 249 | 220 | 130 | 109 | 654 | 546 | 16 | 15 | 38 | 58 | 26 | 183 | 176 |
| 2 | 9 | 6 | 145 | 97 | 545 | 633 | 15 | 16 | 47 | 52 | 32 | 187 | 325 | 172 | 111 | 582 | 618 | 19 | 17 | 53 | 74 | 36 | 202 | 254 |
| 2 | 9 | 6 | 199 | 103 | 755 | 445 | 16 | 17 | 55 | 81 | 40 | 132 | 174 | 274 | 111 | 780 | 420 | 17 | 18 | 59 | 103 | 46 | 152 | 145 |
| 2 | 9 | 6 | 136 | 104 | 483 | 427 | 14 | 13 | 45 | 53 | 36 | 121 | 150 | 241 | 98 | 667 | 533 | 17 | 18 | 58 | 100 | 47 | 122 | 180 |
| 2 | 9 | 6 | 45 | 38 | 159 | 1001 | 5 | 4 | 19 | 15 | 15 | 50 | 33 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 9 | 6 | 236 | 114 | 555 | 617 | 16 | 16 | 61 | 79 | 48 | 103 | 356 | 240 | 82 | 872 | 328 | 16 | 15 | 53 | 81 | 36 | 153 | 145 |
| 2 | 10 | 6 | 180 | 133 | 682 | 491 | 18 | 17 | 61 | 90 | 53 | 149 | 194 | 205 | 144 | 668 | 532 | 15 | 18 | 69 | 106 | 58 | 157 | 196 |
| 2 | 10 | 6 | 122 | 81 | 758 | 435 | 11 | 10 | 40 | 58 | 28 | 556 | 205 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1201 | 0 |
| 2 | 10 | 6 | 190 | 144 | 614 | 553 | 18 | 17 | 66 | 100 | 50 | 154 | 192 | 165 | 98 | 603 | 597 | 15 | 15 | 56 | 82 | 36 | 140 | 324 |
| 2 | 10 | 6 | 194 | 150 | 596 | 593 | 17 | 18 | 68 | 97 | 60 | 138 | 198 | 165 | 87 | 666 | 534 | 17 | 16 | 50 | 87 | 34 | 249 | 281 |
| 2 | 10 | 6 | 203 | 138 | 511 | 583 | 17 | 17 | 65 | 101 | 49 | 104 | 182 | 101 | 96 | 407 | 793 | 14 | 13 | 37 | 58 | 23 | 141 | 202 |
| 2 | 11 | 6 | 328 | 165 | 787 | 397 | 34 | 7 | 90 | 142 | 79 | 217 | 72 | 267 | 117 | 864 | 336 | 32 | 9 | 63 | 91 | 46 | 212 | 76 |
| 2 | 11 | 6 | 345 | 130 | 812 | 377 | 31 | 9 | 78 | 125 | 54 | 157 | 101 | 235 | 106 | 807 | 393 | 29 | 6 | 59 | 86 | 41 | 229 | 73 |
| 2 | 11 | 6 | 328 | 151 | 815 | 378 | 34 | 7 | 80 | 120 | 68 | 184 | 66 | 280 | 101 | 920 | 280 | 29 | 8 | 55 | 96 | 38 | 300 | 72 |
| 2 | 11 | 6 | 245 | 143 | 727 | 468 | 28 | 8 | 77 | 107 | 60 | 171 | 99 | 222 | 162 | 670 | 530 | 30 | 6 | 77 | 90 | 52 | 176 | 72 |
| 2 | 11 | 6 | 250 | 154 | 725 | 470 | 31 | 6 | 83 | 122 | 61 | 188 | 57 | 265 | 129 | 772 | 428 | 29 | 9 | 71 | 108 | 48 | 250 | 86 |
| 2 | 12 | 6 | 82 | 236 | 190 | 1004 | 9 | 30 | 43 | 59 | 35 | 62 | 256 | 72 | 184 | 178 | 1022 | 6 | 30 | 35 | 42 | 24 | 53 | 284 |
| 2 | 12 | 6 | 84 | 182 | 202 | 989 | 8 | 27 | 44 | 62 | 34 | 73 | 312 | 128 | 165 | 213 | 987 | 6 | 30 | 46 | 75 | 37 | 39 | 354 |
| 2 | 12 | 6 | 97 | 146 | 236 | 958 | 7 | 29 | 45 | 57 | 39 | 33 | 398 | 71 | 142 | 208 | 992 | 7 | 29 | 31 | 46 | 23 | 55 | 439 |
| 2 | 12 | 6 | 46 | 177 | 101 | 1090 | 4 | 27 | 30 | 35 | 25 | 28 | 314 | 88 | 191 | 180 | 1020 | 9 | 28 | 48 | 59 | 37 | 54 | 275 |
| 2 | 12 | 6 | 81 | 173 | 177 | 1015 | 7 | 25 | 38 | 54 | 32 | 63 | 251 | 51 | 111 | 297 | 903 | 5 | 15 | 25 | 30 | 19 | 186 | 172 |
| 2 | 13 | 6 | 167 | 44 | 1048 | 129 | 28 | 2 | 32 | 47 | 20 | 239 | 18 | 34 | 9 | 965 | 235 | 6 | 1 | 9 | 16 | 4 | 13 | 11 |
| 2 | 13 | 6 | 181 | 59 | 1039 | 155 | 30 | 4 | 37 | 60 | 30 | 372 | 42 | 128 | 46 | 981 | 219 | 24 | 4 | 32 | 51 | 20 | 237 | 31 |
| 2 | 13 | 6 | 177 | 78 | 1009 | 174 | 29 | 3 | 45 | 64 | 33 | 280 | 24 | 50 | 13 | 1116 | 84 | 12 | 1 | 12 | 18 | 8 | 283 | 8 |
| 2 | 13 | 6 | 183 | 82 | 919 | 243 | 29 | 4 | 45 | 75 | 37 | 282 | 43 | 42 | 17 | 789 | 411 | 10 | 1 | 13 | 13 | 8 | 274 | 6 |
| 2 | 13 | 6 | 206 | 90 | 929 | 246 | 35 | 6 | 47 | 74 | 35 | 244 | 54 | 92 | 42 | 950 | 250 | 15 | 1 | 24 | 32 | 17 | 176 | 18 |
| 2 | 14 | 6 | 25 | 195 | 85 | 1105 | 4 | 28 | 20 | 19 | 15 | 20 | 308 | 28 | 175 | 92 | 1108 | 4 | 34 | 18 | 20 | 11 | 36 | 356 |
| 2 | 14 | 6 | 31 | 166 | 62 | 1131 | 3 | 31 | 18 | 19 | 13 | 15 | 429 | 48 | 169 | 91 | 1109 | 3 | 34 | 26 | 30 | 17 | 15 | 434 |
| 2 | 14 | 6 | 19 | 124 | 105 | 1088 | 3 | 30 | 14 | 10 | 9 | 13 | 455 | 12 | 170 | 69 | 1131 | 3 | 32 | 8 | 5 | 6 | 14 | 362 |
| 2 | 14 | 6 | 55 | 207 | 117 | 1049 | 3 | 38 | 32 | 35 | 26 | 19 | 326 | 56 | 217 | 134 | 1066 | 6 | 32 | 30 | 38 | 22 | 22 | 272 |
| 2 | 14 | 6 | 9 | 181 | 31 | 1160 | 2 | 36 | 12 | 7 | 7 | 10 | 328 | 30 | 195 | 62 | 1138 | 5 | 30 | 16 | 25 | 10 | 18 | 288 |
| 2 | 15 | 6 | 325 | 146 | 690 | 498 | 32 | 9 | 92 | 126 | 64 | 133 | 100 | 240 | 120 | 816 | 384 | 31 | 7 | 58 | 79 | 43 | 269 | 99 |
| 2 | 15 | 6 | 246 | 115 | 846 | 344 | 34 | 7 | 64 | 84 | 50 | 242 | 93 | 298 | 87 | 922 | 278 | 30 | 8 | 48 | 74 | 42 | 317 | 93 |
| 2 | 15 | 6 | 320 | 177 | 706 | 488 | 32 | 9 | 92 | 116 | 71 | 151 | 112 | 244 | 111 | 890 | 310 | 33 | 7 | 60 | 78 | 43 | 169 | 73 |
| 2 | 15 | 6 | 323 | 169 | 741 | 430 | 35 | 7 | 90 | 115 | 68 | 159 | 59 | 293 | 144 | 761 | 439 | 32 | 9 | 77 | 109 | 51 | 120 | 91 |
| 2 | 15 | 6 | 320 | 180 | 737 | 457 | 33 | 9 | 91 | 117 | 78 | 132 | 103 | 248 | 119 | 834 | 366 | 31 | 8 | 59 | 76 | 44 | 191 | 85 |
| 2 | 16 | 4 | 264 | 127 | 756 | 433 | 32 | 6 | 82 | 97 | 62 | 206 | 97 | 270 | 122 | 822 | 378 | 31 | 10 | 71 | 111 | 57 | 186 | 88 |
| 2 | 16 | 4 | 245 | 135 | 729 | 462 | 28 | 9 | 79 | 105 | 62 | 169 | 101 | 286 | 134 | 776 | 424 | 34 | 8 | 72 | 108 | 49 | 181 | 114 |
| 2 | 16 | 4 | 256 | 122 | 803 | 384 | 32 | 9 | 72 | 90 | 52 | 235 | 91 | 245 | 131 | 766 | 434 | 30 | 7 | 65 | 96 | 41 | 188 | 88 |
| 2 | 16 | 4 | 252 | 155 | 793 | 393 | 34 | 7 | 71 | 93 | 55 | 204 | 81 | 235 | 127 | 833 | 367 | 28 | 8 | 64 | 74 | 50 | 248 | 98 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 16 | 4 | 298 | 182 | 734 | 461 | 34 | 7 | 88 | 111 | 70 | 201 | 67 | 223 | 119 | 886 | 314 | 30 | 9 | 62 | 69 | 48 | 152 | 75 |
| 2 | 17 | 4 | 121 | 267 | 246 | 945 | 6 | 33 | 72 | 81 | 62 | 62 | 236 | 73 | 193 | 253 | 947 | 10 | 29 | 43 | 45 | 38 | 107 | 291 |
| 2 | 17 | 4 | 33 | 203 | 101 | 1050 | 4 | 22 | 29 | 28 | 26 | 29 | 257 | 95 | 245 | 210 | 990 | 8 | 29 | 57 | 59 | 52 | 44 | 247 |
| 2 | 17 | 4 | 117 | 211 | 225 | 805 | 7 | 26 | 56 | 65 | 45 | 47 | 254 | 22 | 142 | 68 | 1132 | 4 | 20 | 16 | 14 | 10 | 18 | 550 |
| 2 | 17 | 4 | 69 | 200 | 147 | 1049 | 6 | 31 | 36 | 39 | 32 | 56 | 333 | 58 | 183 | 155 | 1045 | 8 | 28 | 30 | 28 | 20 | 55 | 359 |
| 2 | 17 | 4 | 82 | 229 | 174 | 1009 | 7 | 31 | 44 | 48 | 40 | 49 | 294 | 63 | 202 | 163 | 1037 | 8 | 32 | 40 | 38 | 31 | 50 | 339 |
| 2 | 18 | 4 | 292 | 98 | 878 | 242 | 35 | 3 | 62 | 69 | 44 | 207 | 24 | 183 | 83 | 937 | 263 | 31 | 5 | 46 | 54 | 28 | 265 | 61 |
| 2 | 18 | 4 | 241 | 113 | 859 | 311 | 35 | 5 | 71 | 69 | 39 | 265 | 54 | 192 | 85 | 952 | 248 | 31 | 5 | 48 | 53 | 31 | 385 | 64 |
| 2 | 18 | 4 | 152 | 44 | 1001 | 140 | 24 | 2 | 33 | 41 | 22 | 255 | 29 | 43 | 11 | 1132 | 68 | 7 | 3 | 8 | 7 | 5 | 117 | 41 |
| 2 | 18 | 4 | 176 | 76 | 918 | 274 | 34 | 5 | 49 | 46 | 33 | 263 | 59 | 145 | 76 | 953 | 247 | 27 | 4 | 46 | 43 | 28 | 379 | 63 |
| 2 | 18 | 4 | 200 | 51 | 970 | 182 | 33 | 3 | 41 | 40 | 24 | 352 | 49 | 177 | 75 | 979 | 221 | 34 | 4 | 44 | 40 | 25 | 385 | 49 |
| 2 | 19 | 4 | 22 | 123 | 65 | 1033 | 3 | 23 | 14 | 15 | 8 | 22 | 302 | 10 | 40 | 39 | 1161 | 1 | 10 | 6 | 5 | 4 | 12 | 194 |
| 2 | 19 | 4 | 18 | 130 | 167 | 1001 | 4 | 30 | 12 | 10 | 7 | 125 | 346 | 42 | 14 | 1069 | 131 | 1 | 3 | 1 | 1 | 0 | 32 | 60 |
| 2 | 19 | 4 | 53 | 144 | 142 | 1051 | 4 | 29 | 28 | 24 | 18 | 42 | 338 | 19 | 136 | 95 | 1105 | 3 | 35 | 18 | 12 | 12 | 44 | 500 |
| 2 | 19 | 4 | 5 | 135 | 21 | 862 | 2 | 26 | 4 | 3 | 4 | 11 | 317 | 18 | 224 | 62 | 1138 | 4 | 27 | 16 | 13 | 10 | 28 | 269 |
| 2 | 19 | 4 | 16 | 120 | 83 | 1067 | 3 | 28 | 12 | 12 | 7 | 53 | 477 | 19 | 69 | 35 | 1165 | 1 | 21 | 8 | 7 | 6 | 6 | 746 |
| 2 | 20 | 4 | 211 | 113 | 774 | 416 | 29 | 9 | 62 | 50 | 43 | 196 | 138 | 221 | 110 | 846 | 354 | 28 | 5 | 64 | 65 | 39 | 302 | 78 |
| 2 | 20 | 4 | 241 | 111 | 772 | 406 | 30 | 8 | 71 | 58 | 47 | 210 | 98 | 178 | 133 | 790 | 410 | 28 | 4 | 63 | 57 | 42 | 148 | 77 |
| 2 | 20 | 4 | 143 | 60 | 406 | 184 | 16 | 5 | 40 | 45 | 27 | 109 | 54 | 212 | 104 | 892 | 308 | 33 | 7 | 66 | 49 | 44 | 195 | 78 |
| 2 | 20 | 4 | 77 | 45 | 898 | 178 | 15 | 4 | 29 | 27 | 21 | 695 | 81 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 | 0 |
| 2 | 20 | 4 | 125 | 78 | 904 | 238 | 23 | 5 | 53 | 43 | 38 | 560 | 51 | 17 | 14 | 1142 | 58 | 4 | 2 | 8 | 5 | 4 | 1045 | 21 |
| 2 | 21 | 4 | 217 | 126 | 607 | 491 | 16 | 17 | 68 | 87 | 42 | 165 | 193 | 186 | 122 | 679 | 521 | 19 | 18 | 54 | 59 | 39 | 122 | 245 |
| 2 | 21 | 4 | 222 | 127 | 521 | 550 | 19 | 17 | 73 | 99 | 44 | 120 | 204 | 241 | 145 | 581 | 619 | 17 | 17 | 70 | 99 | 36 | 67 | 199 |
| 2 | 21 | 4 | 258 | 174 | 539 | 658 | 20 | 21 | 79 | 92 | 55 | 116 | 240 | 246 | 139 | 666 | 534 | 19 | 19 | 74 | 100 | 52 | 107 | 188 |
| 2 | 21 | 4 | 210 | 173 | 553 | 642 | 19 | 20 | 77 | 79 | 52 | 130 | 234 | 142 | 116 | 615 | 585 | 18 | 17 | 49 | 56 | 32 | 104 | 290 |
| 2 | 21 | 4 | 223 | 155 | 564 | 619 | 21 | 20 | 75 | 86 | 44 | 122 | 238 | 261 | 184 | 619 | 581 | 19 | 20 | 84 | 111 | 47 | 113 | 152 |
| 3 | 1 | 0 | 202 | 96 | 749 | 417 | 15 | 15 | 40 | 62 | 38 | 144 | 218 | 167 | 90 | 635 | 565 | 15 | 16 | 41 | 55 | 35 | 151 | 277 |
| 3 | 1 | 0 | 206 | 105 | 632 | 553 | 15 | 17 | 42 | 68 | 42 | 189 | 252 | 225 | 99 | 798 | 402 | 15 | 15 | 44 | 58 | 33 | 189 | 197 |
| 3 | 1 | 0 | 252 | 129 | 751 | 408 | 17 | 17 | 50 | 82 | 53 | 174 | 165 | 190 | 113 | 822 | 378 | 17 | 17 | 44 | 61 | 51 | 316 | 184 |
| 3 | 1 | 0 | 247 | 100 | 823 | 346 | 15 | 16 | 43 | 77 | 44 | 201 | 158 | 230 | 95 | 909 | 291 | 15 | 14 | 47 | 76 | 49 | 158 | 99 |
| 3 | 1 | 0 | 302 | 110 | 880 | 284 | 15 | 15 | 53 | 80 | 51 | 226 | 102 | 263 | 135 | 878 | 322 | 17 | 16 | 49 | 80 | 55 | 247 | 127 |
| 3 | 2 | 0 | 168 | 218 | 512 | 679 | 18 | 17 | 58 | 69 | 61 | 187 | 321 | 96 | 108 | 565 | 635 | 15 | 15 | 33 | 40 | 29 | 304 | 415 |
| 3 | 2 | 0 | 130 | 185 | 494 | 689 | 18 | 16 | 41 | 60 | 44 | 231 | 373 | 90 | 108 | 592 | 608 | 16 | 17 | 28 | 37 | 38 | 311 | 418 |
| 3 | 2 | 0 | 173 | 224 | 486 | 703 | 18 | 16 | 51 | 63 | 55 | 176 | 348 | 67 | 83 | 606 | 594 | 15 | 15 | 24 | 22 | 26 | 388 | 440 |
| 3 | 2 | 0 | 98 | 159 | 481 | 705 | 17 | 16 | 35 | 40 | 37 | 226 | 427 | 80 | 104 | 585 | 615 | 14 | 14 | 28 | 29 | 30 | 292 | 407 |
| 3 | 2 | 0 | 119 | 171 | 485 | 702 | 16 | 17 | 41 | 49 | 37 | 183 | 387 | 81 | 93 | 622 | 578 | 14 | 13 | 33 | 35 | 30 | 389 | 397 |
| 3 | 4 | 2 | 174 | 276 | 537 | 654 | 19 | 18 | 57 | 66 | 67 | 202 | 223 | 113 | 194 | 546 | 654 | 18 | 18 | 44 | 41 | 48 | 294 | 238 |
| 3 | 4 | 2 | 127 | 277 | 439 | 750 | 17 | 19 | 52 | 67 | 59 | 182 | 229 | 127 | 262 | 510 | 690 | 16 | 17 | 46 | 55 | 50 | 267 | 193 |
| 3 | 4 | 2 | 128 | 276 | 488 | 712 | 17 | 17 | 46 | 52 | 54 | 228 | 255 | 197 | 313 | 667 | 533 | 19 | 17 | 55 | 71 | 54 | 299 | 52 |
| 3 | 4 | 2 | 121 | 316 | 378 | 773 | 16 | 17 | 50 | 51 | 70 | 131 | 269 | 88 | 180 | 489 | 711 | 15 | 14 | 36 | 40 | 36 | 224 | 354 |
| 3 | 4 | 2 | 98 | 171 | 570 | 613 | 17 | 17 | 38 | 39 | 40 | 336 | 308 | 90 | 111 | 638 | 562 | 15 | 15 | 31 | 37 | 30 | 400 | 354 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 6 | 2 | 330 | 330 | 614 | 576 | 19 | 21 | 84 | 136 | 99 | 158 | 95 | 270 | 259 | 693 | 507 | 20 | 19 | 69 | 87 | 87 | 230 | 130 |
| 3 | 6 | 2 | 242 | 331 | 526 | 660 | 20 | 19 | 76 | 109 | 101 | 110 | 144 | 264 | 276 | 643 | 557 | 19 | 20 | 68 | 96 | 89 | 205 | 144 |
| 3 | 6 | 2 | 245 | 284 | 550 | 639 | 20 | 19 | 73 | 99 | 90 | 158 | 184 | 223 | 305 | 552 | 648 | 18 | 18 | 74 | 97 | 105 | 142 | 163 |
| 3 | 6 | 2 | 255 | 296 | 512 | 682 | 18 | 20 | 72 | 100 | 82 | 116 | 217 | 145 | 222 | 632 | 568 | 17 | 18 | 54 | 61 | 55 | 269 | 244 |
| 3 | 6 | 2 | 241 | 239 | 639 | 551 | 19 | 18 | 66 | 88 | 76 | 168 | 182 | 188 | 151 | 747 | 453 | 17 | 16 | 50 | 65 | 55 | 319 | 162 |
| 3 | 7 | 4 | 218 | 226 | 638 | 549 | 18 | 18 | 66 | 78 | 77 | 185 | 132 | 218 | 258 | 646 | 554 | 17 | 19 | 68 | 76 | 86 | 169 | 153 |
| 3 | 7 | 4 | 298 | 242 | 624 | 562 | 19 | 21 | 77 | 114 | 112 | 133 | 165 | 248 | 210 | 742 | 458 | 21 | 17 | 66 | 86 | 80 | 181 | 123 |
| 3 | 7 | 4 | 248 | 231 | 622 | 558 | 19 | 17 | 68 | 96 | 87 | 155 | 102 | 231 | 208 | 742 | 458 | 19 | 18 | 63 | 88 | 81 | 142 | 99 |
| 3 | 7 | 4 | 256 | 196 | 647 | 515 | 18 | 18 | 63 | 98 | 81 | 115 | 126 | 253 | 231 | 687 | 513 | 17 | 19 | 73 | 102 | 91 | 115 | 108 |
| 3 | 7 | 4 | 240 | 230 | 623 | 566 | 17 | 19 | 68 | 85 | 91 | 122 | 178 | 225 | 173 | 725 | 475 | 18 | 20 | 62 | 69 | 71 | 144 | 150 |
| 3 | 8 | 4 | 224 | 304 | 596 | 598 | 21 | 18 | 65 | 91 | 89 | 175 | 149 | 160 | 199 | 601 | 599 | 18 | 17 | 50 | 74 | 57 | 263 | 177 |
| 3 | 8 | 4 | 261 | 288 | 585 | 609 | 17 | 16 | 65 | 86 | 82 | 119 | 104 | 174 | 245 | 633 | 567 | 16 | 17 | 53 | 72 | 63 | 270 | 123 |
| 3 | 8 | 4 | 205 | 184 | 658 | 514 | 17 | 17 | 57 | 79 | 69 | 232 | 170 | 231 | 251 | 655 | 545 | 18 | 17 | 63 | 97 | 68 | 249 | 138 |
| 3 | 8 | 4 | 179 | 202 | 619 | 573 | 17 | 19 | 52 | 72 | 65 | 228 | 160 | 172 | 185 | 726 | 474 | 19 | 17 | 51 | 68 | 65 | 336 | 141 |
| 3 | 8 | 4 | 153 | 175 | 607 | 541 | 15 | 15 | 45 | 67 | 55 | 304 | 230 | 141 | 162 | 617 | 583 | 17 | 17 | 43 | 44 | 63 | 223 | 256 |
| 3 | 9 | 6 | 195 | 102 | 705 | 487 | 14 | 14 | 48 | 77 | 43 | 181 | 72 | 200 | 135 | 789 | 411 | 19 | 17 | 53 | 68 | 45 | 191 | 93 |
| 3 | 9 | 6 | 286 | 195 | 684 | 500 | 20 | 19 | 70 | 98 | 76 | 167 | 149 | 192 | 145 | 725 | 475 | 15 | 15 | 57 | 83 | 57 | 114 | 124 |
| 3 | 9 | 6 | 105 | 51 | 341 | 831 | 8 | 7 | 25 | 43 | 23 | 68 | 66 | 212 | 130 | 859 | 341 | 15 | 17 | 50 | 56 | 54 | 132 | 116 |
| 3 | 9 | 6 | 252 | 124 | 783 | 409 | 15 | 16 | 52 | 78 | 59 | 172 | 134 | 179 | 66 | 879 | 321 | 14 | 12 | 36 | 53 | 35 | 162 | 78 |
| 3 | 9 | 6 | 238 | 121 | 744 | 427 | 15 | 15 | 48 | 72 | 51 | 151 | 132 | 123 | 53 | 812 | 388 | 10 | 11 | 31 | 40 | 27 | 81 | 122 |
| 3 | 10 | 6 | 23 | 16 | 116 | 1083 | 3 | 1 | 7 | 14 | 4 | 72 | 8 | 53 | 103 | 183 | 1017 | 7 | 10 | 21 | 22 | 23 | 49 | 92 |
| 3 | 10 | 6 | 153 | 214 | 439 | 728 | 15 | 15 | 51 | 76 | 61 | 142 | 130 | 107 | 131 | 352 | 848 | 11 | 13 | 37 | 45 | 37 | 104 | 103 |
| 3 | 10 | 6 | 119 | 144 | 651 | 544 | 15 | 15 | 44 | 56 | 50 | 333 | 151 | 109 | 163 | 402 | 798 | 14 | 14 | 40 | 46 | 42 | 199 | 160 |
| 3 | 10 | 6 | 136 | 207 | 397 | 798 | 16 | 16 | 49 | 70 | 52 | 164 | 202 | 93 | 204 | 401 | 799 | 14 | 15 | 41 | 49 | 45 | 239 | 136 |
| 3 | 10 | 6 | 131 | 178 | 584 | 603 | 17 | 16 | 45 | 58 | 43 | 333 | 172 | 106 | 226 | 387 | 813 | 17 | 17 | 51 | 55 | 50 | 184 | 160 |
| 3 | 11 | 6 | 139 | 85 | 903 | 241 | 30 | 6 | 34 | 41 | 38 | 407 | 121 | 178 | 129 | 853 | 347 | 29 | 9 | 52 | 53 | 45 | 322 | 162 |
| 3 | 11 | 6 | 195 | 196 | 769 | 419 | 31 | 7 | 59 | 76 | 62 | 250 | 143 | 160 | 126 | 838 | 362 | 27 | 8 | 49 | 58 | 42 | 352 | 176 |
| 3 | 11 | 6 | 200 | 175 | 853 | 328 | 31 | 6 | 59 | 73 | 68 | 337 | 114 | 165 | 144 | 795 | 405 | 27 | 9 | 51 | 62 | 44 | 334 | 172 |
| 3 | 11 | 6 | 165 | 178 | 752 | 421 | 27 | 6 | 55 | 68 | 46 | 339 | 144 | 190 | 181 | 737 | 463 | 29 | 8 | 60 | 76 | 56 | 222 | 134 |
| 3 | 11 | 6 | 124 | 121 | 875 | 296 | 27 | 5 | 43 | 45 | 43 | 514 | 104 | 142 | 88 | 902 | 298 | 27 | 8 | 44 | 42 | 32 | 401 | 103 |
| 3 | 12 | 6 | 114 | 241 | 302 | 893 | 6 | 25 | 34 | 58 | 38 | 115 | 196 | 51 | 123 | 173 | 1027 | 4 | 17 | 22 | 26 | 19 | 86 | 110 |
| 3 | 12 | 6 | 101 | 275 | 189 | 972 | 6 | 31 | 41 | 58 | 39 | 62 | 267 | 99 | 315 | 378 | 822 | 6 | 26 | 37 | 48 | 37 | 100 | 247 |
| 3 | 12 | 6 | 98 | 261 | 279 | 914 | 6 | 28 | 37 | 49 | 38 | 99 | 311 | 82 | 184 | 324 | 876 | 7 | 27 | 39 | 42 | 36 | 180 | 316 |
| 3 | 12 | 6 | 176 | 215 | 390 | 797 | 6 | 28 | 45 | 72 | 47 | 167 | 203 | 81 | 194 | 384 | 816 | 6 | 26 | 31 | 35 | 31 | 179 | 185 |
| 3 | 12 | 6 | 128 | 319 | 229 | 957 | 6 | 34 | 38 | 53 | 43 | 70 | 278 | 87 | 240 | 243 | 957 | 9 | 29 | 34 | 41 | 27 | 97 | 331 |
| 3 | 13 | 6 | 136 | 8 | 952 | 155 | 22 | 2 | 9 | 15 | 5 | 405 | 16 | 188 | 26 | 1090 | 110 | 26 | 4 | 20 | 20 | 2 | 420 | 38 |
| 3 | 13 | 6 | 166 | 120 | 937 | 251 | 33 | 4 | 46 | 57 | 47 | 448 | 65 | 97 | 60 | 1071 | 129 | 31 | 2 | 24 | 26 | 27 | 636 | 37 |
| 3 | 13 | 6 | 199 | 113 | 941 | 234 | 32 | 6 | 40 | 55 | 50 | 335 | 55 | 141 | 63 | 1042 | 158 | 33 | 4 | 24 | 26 | 27 | 499 | 60 |
| 3 | 13 | 6 | 39 | 4 | 359 | 31 | 5 | 1 | 4 | 2 | 2 | 136 | 5 | 16 | 8 | 167 | 1033 | 3 | 0 | 5 | 4 | 5 | 83 | 0 |
| 3 | 13 | 6 | 160 | 72 | 868 | 321 | 28 | 2 | 31 | 41 | 22 | 190 | 37 | 25 | 16 | 686 | 514 | 5 | 0 | 8 | 7 | 5 | 21 | 0 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 1 | 0 | 165 | 172 | 656 | 526 | 17 | 15 | 56 | 71 | 114 | 364 | 371 | 143 | 111 | 696 | 504 | 12 | 13 | 39 | 49 | 73 | 424 | 363 |
| 4 | 1 | 0 | 197 | 170 | 629 | 531 | 15 | 15 | 53 | 78 | 104 | 342 | 341 | 97 | 54 | 905 | 295 | 10 | 7 | 20 | 32 | 41 | 348 | 239 |
| 4 | 1 | 0 | 154 | 126 | 648 | 517 | 15 | 16 | 44 | 63 | 92 | 344 | 364 | 250 | 141 | 695 | 505 | 17 | 17 | 50 | 86 | 89 | 340 | 356 |
| 4 | 1 | 0 | 209 | 184 | 696 | 487 | 16 | 16 | 47 | 72 | 107 | 333 | 303 | 325 | 224 | 746 | 454 | 17 | 17 | 63 | 112 | 126 | 327 | 260 |
| 4 | 1 | 0 | 172 | 94 | 734 | 436 | 15 | 15 | 42 | 66 | 60 | 395 | 296 | 235 | 141 | 791 | 409 | 16 | 15 | 41 | 64 | 101 | 454 | 290 |
| 4 | 2 | 0 | 86 | 101 | 310 | 235 | 7 | 7 | 26 | 37 | 50 | 182 | 123 | 68 | 77 | 839 | 361 | 8 | 7 | 25 | 30 | 38 | 725 | 175 |
| 4 | 2 | 0 | 304 | 190 | 963 | 202 | 15 | 15 | 65 | 112 | 120 | 450 | 21 | 298 | 106 | 1066 | 134 | 9 | 10 | 52 | 75 | 72 | 253 | 29 |
| 4 | 2 | 0 | 80 | 119 | 662 | 513 | 12 | 11 | 32 | 46 | 49 | 549 | 293 | 30 | 25 | 443 | 757 | 5 | 7 | 10 | 13 | 12 | 196 | 608 |
| 4 | 2 | 0 | 167 | 163 | 723 | 439 | 15 | 15 | 55 | 75 | 97 | 449 | 227 | 53 | 94 | 761 | 439 | 7 | 5 | 22 | 27 | 33 | 664 | 109 |
| 4 | 2 | 0 | 134 | 151 | 711 | 463 | 15 | 16 | 41 | 50 | 93 | 471 | 282 | 139 | 142 | 825 | 375 | 12 | 10 | 42 | 56 | 78 | 623 | 155 |
| 4 | 4 | 2 | 133 | 158 | 690 | 438 | 14 | 13 | 42 | 59 | 79 | 396 | 223 | 171 | 197 | 693 | 507 | 14 | 14 | 50 | 79 | 99 | 436 | 297 |
| 4 | 4 | 2 | 64 | 109 | 531 | 646 | 12 | 13 | 30 | 30 | 42 | 361 | 390 | 85 | 69 | 643 | 557 | 14 | 14 | 24 | 37 | 38 | 395 | 400 |
| 4 | 4 | 2 | 102 | 138 | 642 | 534 | 15 | 14 | 39 | 58 | 72 | 461 | 364 | 91 | 124 | 546 | 654 | 12 | 14 | 32 | 42 | 75 | 272 | 481 |
| 4 | 4 | 2 | 127 | 182 | 550 | 573 | 14 | 15 | 44 | 73 | 97 | 363 | 365 | 158 | 137 | 757 | 443 | 15 | 13 | 39 | 90 | 87 | 559 | 294 |
| 4 | 4 | 2 | 94 | 152 | 681 | 487 | 14 | 13 | 33 | 53 | 66 | 433 | 246 | 85 | 120 | 530 | 670 | 11 | 11 | 30 | 46 | 50 | 394 | 232 |
| 4 | 6 | 2 | 119 | 210 | 631 | 554 | 15 | 18 | 46 | 60 | 112 | 357 | 305 | 157 | 186 | 671 | 529 | 17 | 17 | 52 | 73 | 112 | 352 | 296 |
| 4 | 6 | 2 | 140 | 216 | 524 | 650 | 15 | 15 | 50 | 69 | 127 | 283 | 396 | 184 | 237 | 532 | 668 | 16 | 17 | 54 | 92 | 139 | 255 | 437 |
| 4 | 6 | 2 | 93 | 150 | 577 | 604 | 12 | 14 | 35 | 44 | 92 | 270 | 433 | 129 | 175 | 584 | 616 | 18 | 17 | 43 | 62 | 104 | 342 | 414 |
| 4 | 6 | 2 | 148 | 181 | 560 | 613 | 16 | 16 | 47 | 74 | 114 | 281 | 386 | 131 | 166 | 638 | 562 | 17 | 17 | 39 | 66 | 98 | 374 | 340 |
| 4 | 6 | 2 | 148 | 205 | 647 | 519 | 17 | 15 | 49 | 64 | 109 | 346 | 293 | 119 | 149 | 626 | 574 | 15 | 15 | 34 | 60 | 86 | 366 | 404 |
| 4 | 7 | 4 | 132 | 182 | 485 | 709 | 15 | 14 | 39 | 69 | 91 | 291 | 355 | 153 | 159 | 642 | 558 | 15 | 16 | 37 | 64 | 99 | 401 | 314 |
| 4 | 7 | 4 | 145 | 153 | 659 | 472 | 17 | 15 | 37 | 54 | 87 | 375 | 253 | 137 | 118 | 823 | 377 | 11 | 11 | 34 | 75 | 77 | 611 | 225 |
| 4 | 7 | 4 | 90 | 81 | 659 | 446 | 13 | 11 | 26 | 39 | 56 | 315 | 323 | 114 | 141 | 657 | 543 | 12 | 12 | 34 | 61 | 78 | 313 | 295 |
| 4 | 7 | 4 | 116 | 158 | 572 | 566 | 14 | 15 | 36 | 63 | 82 | 350 | 340 | 112 | 131 | 676 | 524 | 14 | 12 | 35 | 58 | 83 | 504 | 340 |
| 4 | 7 | 4 | 100 | 206 | 449 | 715 | 14 | 15 | 38 | 63 | 101 | 291 | 385 | 120 | 145 | 725 | 475 | 15 | 12 | 35 | 56 | 97 | 295 | 291 |
| 4 | 8 | 4 | 140 | 248 | 491 | 686 | 15 | 16 | 48 | 83 | 128 | 328 | 325 | 140 | 213 | 598 | 602 | 15 | 14 | 47 | 83 | 98 | 422 | 263 |
| 4 | 8 | 4 | 137 | 199 | 547 | 614 | 16 | 15 | 47 | 84 | 111 | 365 | 335 | 149 | 205 | 641 | 559 | 16 | 16 | 46 | 86 | 118 | 428 | 268 |
| 4 | 8 | 4 | 115 | 212 | 486 | 691 | 15 | 15 | 45 | 75 | 105 | 333 | 326 | 127 | 225 | 498 | 702 | 15 | 14 | 48 | 80 | 121 | 334 | 330 |
| 4 | 8 | 4 | 114 | 246 | 516 | 663 | 15 | 14 | 43 | 66 | 111 | 355 | 343 | 125 | 236 | 587 | 613 | 15 | 15 | 48 | 72 | 125 | 421 | 326 |
| 4 | 8 | 4 | 143 | 226 | 557 | 598 | 16 | 15 | 42 | 70 | 113 | 365 | 341 | 160 | 245 | 551 | 649 | 15 | 15 | 54 | 100 | 139 | 369 | 379 |
| 4 | 9 | 6 | 120 | 118 | 535 | 600 | 13 | 14 | 32 | 65 | 68 | 370 | 354 | 173 | 144 | 688 | 512 | 15 | 14 | 37 | 73 | 87 | 404 | 312 |
| 4 | 9 | 6 | 121 | 114 | 639 | 518 | 15 | 15 | 35 | 56 | 79 | 434 | 355 | 169 | 158 | 665 | 535 | 14 | 14 | 46 | 66 | 100 | 398 | 324 |
| 4 | 9 | 6 | 108 | 98 | 573 | 591 | 12 | 13 | 26 | 40 | 61 | 365 | 391 | 106 | 141 | 637 | 563 | 12 | 13 | 31 | 51 | 84 | 397 | 351 |
| 4 | 9 | 6 | 118 | 110 | 585 | 563 | 11 | 12 | 33 | 52 | 70 | 352 | 403 | 130 | 111 | 700 | 500 | 12 | 13 | 31 | 47 | 73 | 404 | 355 |
| 4 | 9 | 6 | 124 | 123 | 598 | 582 | 14 | 15 | 30 | 57 | 73 | 369 | 367 | 119 | 112 | 668 | 532 | 15 | 13 | 33 | 61 | 65 | 458 | 309 |
| 4 | 10 | 6 | 76 | 226 | 389 | 776 | 12 | 12 | 39 | 49 | 84 | 261 | 262 | 69 | 134 | 769 | 431 | 8 | 9 | 30 | 45 | 69 | 688 | 224 |
| 4 | 10 | 6 | 104 | 153 | 486 | 562 | 14 | 14 | 37 | 50 | 88 | 345 | 267 | 81 | 150 | 437 | 763 | 11 | 12 | 33 | 50 | 70 | 284 | 369 |
| 4 | 10 | 6 | 88 | 141 | 616 | 547 | 13 | 13 | 40 | 46 | 83 | 399 | 321 | 87 | 157 | 534 | 666 | 13 | 14 | 38 | 49 | 94 | 395 | 362 |
| 4 | 10 | 6 | 82 | 165 | 540 | 642 | 14 | 14 | 36 | 49 | 80 | 379 | 343 | 103 | 157 | 498 | 702 | 16 | 16 | 39 | 56 | 81 | 348 | 368 |
| 4 | 10 | 6 | 82 | 194 | 451 | 734 | 13 | 14 | 38 | 53 | 86 | 321 | 376 | 74 | 159 | 523 | 677 | 13 | 14 | 36 | 37 | 83 | 350 | 396 |
| 4 | 11 | 6 | 111 | 101 | 787 | 392 | 23 | 7 | 25 | 44 | 58 | 567 | 208 | 115 | 108 | 921 | 279 | 26 | 5 | 29 | 49 | 67 | 678 | 126 |

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| 4 | 11 | 6 | 135 | 149 | 781 | 365 | 27 | 5 | 39 | 66 | 80 | 537 | 178 | 102 | 120 | 779 | 421 | 24 | 8 | 32 | 46 | 71 | 563 | 217 |
| 4 | 11 | 6 | 140 | 202 | 773 | 392 | 26 | 5 | 41 | 72 | 105 | 534 | 141 | 84 | 92 | 792 | 408 | 22 | 7 | 23 | 36 | 55 | 595 | 197 |
| 4 | 11 | 6 | 90 | 112 | 759 | 425 | 19 | 7 | 26 | 42 | 59 | 597 | 168 | 125 | 153 | 877 | 323 | 26 | 4 | 31 | 61 | 84 | 610 | 153 |
| 4 | 11 | 6 | 128 | 136 | 859 | 314 | 24 | 7 | 34 | 59 | 88 | 599 | 172 | 69 | 57 | 1007 | 193 | 25 | 4 | 14 | 20 | 38 | 751 | 108 |
| 4 | 12 | 6 | 39 | 174 | 98 | 1083 | 4 | 24 | 16 | 26 | 37 | 54 | 599 | 55 | 181 | 112 | 1088 | 6 | 22 | 24 | 36 | 54 | 47 | 605 |
| 4 | 12 | 6 | 50 | 201 | 197 | 978 | 6 | 23 | 20 | 32 | 42 | 141 | 504 | 65 | 171 | 205 | 995 | 7 | 22 | 30 | 43 | 56 | 137 | 541 |
| 4 | 12 | 6 | 40 | 131 | 140 | 1031 | 6 | 24 | 18 | 32 | 23 | 98 | 610 | 37 | 102 | 140 | 1060 | 4 | 19 | 14 | 27 | 20 | 102 | 669 |
| 4 | 12 | 6 | 32 | 176 | 140 | 1034 | 8 | 25 | 18 | 22 | 32 | 84 | 585 | 41 | 153 | 129 | 1071 | 5 | 26 | 20 | 27 | 41 | 79 | 586 |
| 4 | 12 | 6 | 45 | 166 | 133 | 1054 | 4 | 26 | 20 | 31 | 45 | 87 | 648 | 44 | 185 | 196 | 1004 | 7 | 21 | 22 | 33 | 45 | 144 | 568 |
| 4 | 13 | 6 | 101 | 93 | 940 | 237 | 28 | 1 | 23 | 30 | 50 | 676 | 39 | 110 | 70 | 1039 | 161 | 20 | 3 | 20 | 29 | 44 | 729 | 92 |
| 4 | 13 | 6 | 48 | 34 | 909 | 256 | 17 | 1 | 9 | 16 | 17 | 716 | 35 | 99 | 77 | 962 | 238 | 29 | 3 | 20 | 30 | 49 | 735 | 73 |
| 4 | 13 | 6 | 142 | 126 | 640 | 530 | 24 | 3 | 35 | 53 | 74 | 324 | 120 | 76 | 105 | 956 | 244 | 20 | 2 | 26 | 32 | 60 | 687 | 113 |
| 4 | 13 | 6 | 79 | 73 | 831 | 337 | 25 | 3 | 23 | 27 | 43 | 582 | 104 | 96 | 102 | 634 | 566 | 19 | 2 | 23 | 31 | 64 | 408 | 57 |
| 4 | 13 | 6 | 112 | 101 | 909 | 246 | 25 | 3 | 25 | 39 | 64 | 635 | 85 | 56 | 64 | 1088 | 112 | 12 | 1 | 14 | 20 | 39 | 948 | 23 |
| 4 | 14 | 6 | 14 | 138 | 18 | 1161 | 2 | 22 | 8 | 11 | 19 | 3 | 577 | 15 | 103 | 25 | 1175 | 2 | 13 | 12 | 12 | 31 | 2 | 360 |
| 4 | 14 | 6 | 22 | 163 | 30 | 1135 | 2 | 24 | 10 | 13 | 24 | 7 | 604 | 48 | 221 | 155 | 1045 | 4 | 19 | 30 | 36 | 74 | 2 | 557 |
| 4 | 14 | 6 | 28 | 208 | 40 | 1156 | 2 | 24 | 20 | 25 | 53 | 4 | 636 | 15 | 173 | 38 | 1162 | 2 | 22 | 16 | 12 | 37 | 9 | 562 |
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| 4 | 14 | 6 | 28 | 248 | 45 | 1134 | 3 | 22 | 20 | 25 | 52 | 3 | 536 | 19 | 146 | 28 | 1172 | 3 | 16 | 10 | 15 | 26 | 3 | 384 |
| 4 | 15 | 6 | 113 | 138 | 746 | 388 | 26 | 6 | 30 | 41 | 75 | 502 | 202 | 116 | 166 | 861 | 339 | 26 | 5 | 34 | 39 | 85 | 535 | 180 |
| 4 | 15 | 6 | 100 | 117 | 663 | 495 | 20 | 5 | 30 | 32 | 58 | 382 | 231 | 109 | 127 | 790 | 410 | 19 | 6 | 30 | 42 | 63 | 549 | 223 |
| 4 | 15 | 6 | 79 | 92 | 684 | 476 | 19 | 5 | 22 | 26 | 49 | 471 | 249 | 104 | 144 | 728 | 472 | 19 | 6 | 34 | 44 | 72 | 503 | 218 |
| 4 | 15 | 6 | 132 | 132 | 769 | 390 | 27 | 6 | 38 | 44 | 70 | 458 | 214 | 76 | 87 | 956 | 244 | 12 | 3 | 20 | 23 | 43 | 267 | 144 |
| 4 | 15 | 6 | 94 | 102 | 475 | 214 | 16 | 3 | 24 | 33 | 51 | 289 | 115 | 94 | 91 | 917 | 283 | 19 | 4 | 22 | 26 | 47 | 456 | 169 |
| 4 | 16 | 4 | 58 | 60 | 775 | 323 | 16 | 3 | 15 | 20 | 28 | 626 | 141 | 58 | 90 | 677 | 523 | 16 | 5 | 20 | 22 | 52 | 520 | 299 |
| 4 | 16 | 4 | 104 | 138 | 802 | 359 | 21 | 4 | 31 | 48 | 69 | 579 | 127 | 90 | 85 | 784 | 416 | 19 | 6 | 20 | 34 | 46 | 594 | 257 |
| 4 | 16 | 4 | 89 | 95 | 822 | 337 | 21 | 3 | 23 | 41 | 49 | 635 | 143 | 75 | 58 | 904 | 296 | 13 | 6 | 21 | 29 | 40 | 380 | 191 |
| 4 | 16 | 4 | 32 | 51 | 581 | 504 | 10 | 2 | 11 | 13 | 23 | 504 | 102 | 49 | 62 | 912 | 288 | 15 | 4 | 13 | 14 | 38 | 732 | 193 |
| 4 | 16 | 4 | 107 | 105 | 804 | 363 | 21 | 4 | 25 | 39 | 54 | 566 | 215 | 77 | 82 | 746 | 454 | 22 | 6 | 18 | 27 | 47 | 507 | 322 |
| 4 | 17 | 4 | 37 | 129 | 85 | 1029 | 6 | 15 | 20 | 26 | 47 | 20 | 652 | 30 | 142 | 74 | 1126 | 2 | 13 | 22 | 24 | 42 | 18 | 624 |
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| 4 | 18 | 4 | 49 | 33 | 856 | 251 | 15 | 2 | 9 | 10 | 18 | 645 | 93 | 89 | 45 | 1054 | 146 | 25 | 3 | 16 | 25 | 26 | 741 | 102 |
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| 4 | 18 | 4 | 57 | 58 | 661 | 436 | 16 | 1 | 15 | 19 | 28 | 488 | 38 | 74 | 58 | 868 | 332 | 21 | 4 | 16 | 19 | 32 | 621 | 256 |
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| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 4 | 20 | 4 | 45 | 55 | 594 | 567 | 12 | 2 | 13 | 19 | 31 | 374 | 84 | 77 | 30 | 978 | 222 | 20 | 5 | 10 | 16 | 19 | 596 | 169 |
| 4 | 20 | 4 | 45 | 49 | 974 | 177 | 18 | 2 | 11 | 12 | 21 | 729 | 45 | 29 | 24 | 756 | 444 | 8 | 3 | 5 | 6 | 15 | 654 | 119 |
| 4 | 21 | 4 | 40 | 103 | 422 | 755 | 12 | 11 | 19 | 23 | 44 | 339 | 473 | 47 | 205 | 486 | 714 | 11 | 11 | 38 | 30 | 86 | 351 | 419 |
| 4 | 21 | 4 | 53 | 121 | 463 | 688 | 12 | 13 | 24 | 28 | 53 | 327 | 433 | 40 | 193 | 474 | 726 | 12 | 11 | 30 | 25 | 77 | 361 | 393 |
| 4 | 21 | 4 | 53 | 140 | 538 | 661 | 13 | 14 | 27 | 33 | 64 | 381 | 407 | 52 | 170 | 521 | 679 | 14 | 12 | 31 | 35 | 71 | 420 | 378 |
| 4 | 21 | 4 | 48 | 144 | 408 | 771 | 10 | 12 | 32 | 29 | 66 | 287 | 446 | 55 | 147 | 598 | 602 | 13 | 12 | 30 | 31 | 60 | 443 | 320 |
| 4 | 21 | 4 | 78 | 136 | 489 | 670 | 12 | 12 | 34 | 43 | 72 | 360 | 399 | 70 | 159 | 505 | 695 | 13 | 12 | 32 | 36 | 72 | 377 | 440 |
| 5 | 1 | 0 | 179 | 125 | 701 | 484 | 17 | 16 | 46 | 96 | 62 | 461 | 328 | 114 | 89 | 699 | 501 | 14 | 14 | 30 | 69 | 36 | 538 | 388 |
| 5 | 1 | 0 | 199 | 142 | 670 | 518 | 17 | 16 | 47 | 93 | 58 | 406 | 351 | 117 | 106 | 632 | 568 | 13 | 15 | 33 | 55 | 44 | 450 | 431 |
| 5 | 1 | 0 | 133 | 88 | 680 | 502 | 16 | 15 | 30 | 81 | 39 | 476 | 377 | 54 | 47 | 584 | 616 | 13 | 14 | 16 | 34 | 19 | 489 | 522 |
| 5 | 1 | 0 | 197 | 136 | 665 | 517 | 15 | 14 | 51 | 106 | 57 | 403 | 346 | 99 | 75 | 640 | 560 | 13 | 13 | 30 | 60 | 35 | 476 | 413 |
| 5 | 1 | 0 | 130 | 111 | 658 | 526 | 14 | 15 | 41 | 66 | 49 | 432 | 376 | 117 | 97 | 681 | 519 | 15 | 12 | 35 | 65 | 36 | 493 | 372 |
| 5 | 2 | 0 | 250 | 105 | 737 | 455 | 16 | 15 | 56 | 94 | 46 | 431 | 286 | 165 | 96 | 645 | 555 | 12 | 13 | 41 | 65 | 41 | 452 | 405 |
| 5 | 2 | 0 | 209 | 106 | 679 | 509 | 15 | 16 | 49 | 97 | 40 | 430 | 341 | 150 | 87 | 669 | 531 | 13 | 12 | 41 | 63 | 34 | 475 | 386 |
| 5 | 2 | 0 | 198 | 105 | 665 | 514 | 15 | 16 | 49 | 89 | 40 | 415 | 354 | 96 | 52 | 619 | 581 | 15 | 14 | 26 | 53 | 24 | 481 | 479 |
| 5 | 2 | 0 | 169 | 104 | 673 | 515 | 17 | 16 | 47 | 84 | 44 | 441 | 357 | 169 | 67 | 639 | 561 | 14 | 14 | 39 | 78 | 30 | 445 | 436 |
| 5 | 2 | 0 | 192 | 99 | 683 | 510 | 15 | 14 | 48 | 99 | 38 | 438 | 338 | 96 | 48 | 626 | 574 | 11 | 14 | 30 | 53 | 20 | 450 | 459 |
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| 5 | 4 | 2 | 150 | 87 | 705 | 483 | 15 | 14 | 50 | 64 | 41 | 446 | 323 | 82 | 41 | 607 | 593 | 10 | 10 | 28 | 42 | 17 | 471 | 470 |
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| 5 | 4 | 2 | 186 | 69 | 732 | 447 | 15 | 14 | 46 | 64 | 37 | 413 | 316 | 62 | 31 | 958 | 242 | 6 | 7 | 22 | 24 | 17 | 247 | 174 |
| 5 | 4 | 2 | 137 | 59 | 730 | 463 | 15 | 14 | 38 | 52 | 25 | 455 | 338 | 79 | 30 | 577 | 623 | 8 | 9 | 25 | 37 | 17 | 392 | 281 |
| 5 | 6 | 2 | 142 | 107 | 655 | 517 | 15 | 14 | 48 | 67 | 42 | 400 | 305 | 91 | 74 | 728 | 472 | 12 | 12 | 32 | 48 | 26 | 534 | 337 |
| 5 | 6 | 2 | 169 | 166 | 664 | 524 | 17 | 17 | 56 | 84 | 64 | 408 | 295 | 107 | 60 | 664 | 536 | 13 | 13 | 31 | 50 | 30 | 469 | 431 |
| 5 | 6 | 2 | 201 | 145 | 632 | 558 | 16 | 16 | 64 | 111 | 63 | 355 | 340 | 145 | 94 | 690 | 510 | 14 | 15 | 43 | 58 | 42 | 476 | 339 |
| 5 | 6 | 2 | 184 | 119 | 674 | 510 | 17 | 17 | 54 | 86 | 59 | 411 | 332 | 101 | 76 | 647 | 553 | 15 | 15 | 35 | 50 | 33 | 481 | 413 |
| 5 | 6 | 2 | 133 | 96 | 668 | 517 | 16 | 18 | 39 | 63 | 43 | 454 | 374 | 103 | 68 | 675 | 525 | 15 | 14 | 32 | 48 | 29 | 521 | 403 |
| 5 | 7 | 4 | 133 | 98 | 591 | 591 | 17 | 15 | 48 | 60 | 34 | 403 | 431 | 53 | 52 | 593 | 607 | 12 | 13 | 27 | 24 | 18 | 455 | 506 |
| 5 | 7 | 4 | 115 | 95 | 555 | 631 | 15 | 15 | 48 | 45 | 30 | 364 | 456 | 49 | 66 | 507 | 693 | 11 | 13 | 29 | 24 | 19 | 382 | 551 |
| 5 | 7 | 4 | 106 | 101 | 567 | 618 | 16 | 15 | 43 | 64 | 26 | 406 | 448 | 58 | 48 | 738 | 462 | 11 | 11 | 26 | 21 | 19 | 635 | 365 |
| 5 | 7 | 4 | 107 | 104 | 574 | 609 | 14 | 14 | 47 | 54 | 29 | 397 | 417 | 71 | 56 | 751 | 449 | 10 | 9 | 35 | 38 | 19 | 646 | 334 |
| 5 | 7 | 4 | 161 | 120 | 587 | 599 | 16 | 16 | 56 | 67 | 35 | 385 | 412 | 75 | 58 | 691 | 509 | 10 | 13 | 31 | 32 | 20 | 583 | 401 |
| 5 | 8 | 4 | 148 | 119 | 604 | 588 | 15 | 15 | 50 | 75 | 49 | 377 | 419 | 72 | 73 | 617 | 583 | 14 | 15 | 27 | 33 | 26 | 480 | 443 |
| 5 | 8 | 4 | 152 | 280 | 391 | 792 | 16 | 15 | 80 | 83 | 64 | 157 | 374 | 68 | 361 | 113 | 1087 | 9 | 11 | 66 | 55 | 61 | 4 | 405 |
| 5 | 8 | 4 | 155 | 145 | 580 | 607 | 16 | 16 | 61 | 73 | 42 | 350 | 379 | 79 | 95 | 599 | 601 | 14 | 14 | 33 | 41 | 26 | 458 | 414 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 5 | 9 | 6 | 134 | 83 | 656 | 523 | 16 | 16 | 38 | 55 | 35 | 411 | 362 | 87 | 49 | 654 | 546 | 13 | 13 | 25 | 37 | 22 | 498 | 431 |
| 5 | 9 | 6 | 127 | 58 | 627 | 559 | 14 | 13 | 35 | 45 | 27 | 413 | 439 | 159 | 42 | 720 | 480 | 12 | 12 | 31 | 48 | 26 | 458 | 403 |
| 5 | 9 | 6 | 155 | 58 | 646 | 534 | 14 | 14 | 36 | 55 | 27 | 428 | 430 | 114 | 50 | 722 | 478 | 11 | 12 | 33 | 47 | 26 | 481 | 363 |
| 5 | 9 | 6 | 132 | 56 | 668 | 515 | 15 | 14 | 36 | 54 | 23 | 427 | 407 | 75 | 30 | 658 | 542 | 12 | 12 | 22 | 30 | 15 | 478 | 468 |
| 5 | 10 | 6 | 102 | 85 | 641 | 544 | 13 | 13 | 44 | 60 | 27 | 504 | 355 | 31 | 33 | 775 | 425 | 6 | 8 | 16 | 15 | 12 | 726 | 297 |
| 5 | 10 | 6 | 63 | 41 | 721 | 442 | 10 | 10 | 25 | 35 | 16 | 621 | 338 | 42 | 26 | 978 | 222 | 6 | 5 | 16 | 15 | 12 | 882 | 167 |
| 5 | 10 | 6 | 76 | 56 | 293 | 895 | 9 | 6 | 25 | 31 | 26 | 182 | 811 | 11 | 14 | 291 | 909 | 3 | 3 | 4 | 3 | 3 | 258 | 786 |
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| 5 | 10 | 6 | 117 | 84 | 573 | 609 | 15 | 16 | 43 | 54 | 30 | 401 | 459 | 83 | 74 | 620 | 580 | 13 | 12 | 35 | 43 | 26 | 503 | 411 |
| 5 | 11 | 6 | 123 | 71 | 490 | 703 | 16 | 4 | 35 | 56 | 33 | 287 | 619 | 50 | 38 | 563 | 637 | 14 | 5 | 17 | 21 | 18 | 463 | 584 |
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| 5 | 11 | 6 | 117 | 71 | 926 | 251 | 26 | 6 | 35 | 43 | 37 | 641 | 161 | 63 | 39 | 897 | 303 | 23 | 7 | 18 | 15 | 19 | 730 | 240 |
| 5 | 11 | 6 | 146 | 89 | 867 | 319 | 25 | 8 | 41 | 49 | 39 | 593 | 199 | 95 | 75 | 957 | 243 | 26 | 5 | 34 | 35 | 32 | 749 | 143 |
| 5 | 11 | 6 | 67 | 50 | 327 | 855 | 10 | 3 | 21 | 23 | 22 | 193 | 795 | 20 | 11 | 337 | 863 | 9 | 1 | 4 | 5 | 3 | 283 | 803 |
| 5 | 12 | 6 | 9 | 29 | 26 | 1145 | 1 | 7 | 6 | 8 | 6 | 12 | 1097 | 43 | 97 | 188 | 1012 | 5 | 16 | 26 | 23 | 25 | 110 | 839 |
| 5 | 12 | 6 | 83 | 177 | 206 | 980 | 5 | 29 | 54 | 52 | 37 | 72 | 686 | 42 | 94 | 242 | 958 | 7 | 25 | 26 | 23 | 21 | 172 | 738 |
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| 5 | 13 | 6 | 139 | 61 | 1034 | 151 | 32 | 2 | 32 | 38 | 26 | 719 | 56 | 32 | 15 | 818 | 382 | 9 | 2 | 9 | 6 | 8 | 549 | 87 |
| 5 | 14 | 6 | 22 | 81 | 126 | 1050 | 3 | 24 | 18 | 15 | 17 | 72 | 565 | 6 | 24 | 517 | 683 | 1 | 9 | 2 | 2 | 1 | 503 | 270 |
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| 5 | 15 | 6 | 234 | 171 | 856 | 334 | 31 | 6 | 80 | 100 | 75 | 494 | 135 | 74 | 74 | 762 | 438 | 22 | 7 | 33 | 32 | 28 | 612 | 322 |
| 5 | 15 | 6 | 145 | 110 | 817 | 364 | 28 | 6 | 54 | 51 | 50 | 521 | 222 | 63 | 81 | 786 | 414 | 20 | 7 | 33 | 27 | 26 | 650 | 271 |
| 5 | 15 | 6 | 133 | 108 | 766 | 416 | 26 | 7 | 53 | 58 | 38 | 517 | 243 | 57 | 86 | 842 | 358 | 19 | 5 | 32 | 27 | 27 | 725 | 223 |
| 5 | 15 | 6 | 153 | 121 | 816 | 370 | 27 | 8 | 56 | 55 | 56 | 545 | 223 | 71 | 83 | 909 | 291 | 21 | 4 | 34 | 30 | 29 | 768 | 164 |
| 5 | 16 | 4 | 72 | 29 | 426 | 763 | 12 | 5 | 17 | 16 | 18 | 240 | 724 | 53 | 28 | 829 | 371 | 14 | 3 | 16 | 14 | 17 | 615 | 322 |
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| 5 | 16 | 4 | 84 | 49 | 955 | 219 | 26 | 5 | 22 | 17 | 22 | 641 | 157 | 58 | 33 | 967 | 233 | 16 | 5 | 16 | 16 | 15 | 767 | 175 |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| 5 | 17 | 4 | 81 | 146 | 326 | 861 | 7 | 24 | 44 | 49 | 42 | 156 | 536 | 29 | 79 | 207 | 993 | 6 | 21 | 16 | 14 | 16 | 140 | 690 |
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| 5 | 19 | 4 | 36 | 141 | 145 | 1038 | 3 | 29 | 24 | 24 | 19 | 97 | 739 | 10 | 75 | 117 | 1083 | 3 | 25 | 8 | 7 | 6 | 97 | 824 |
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| 5 | 19 | 4 | 14 | 62 | 163 | 1016 | 4 | 26 | 10 | 9 | 8 | 131 | 814 | 8 | 33 | 55 | 1145 | 1 | 13 | 6 | 6 | 3 | 34 | 465 |
| 5 | 19 | 4 | 21 | 61 | 151 | 1019 | 3 | 22 | 14 | 12 | 11 | 89 | 634 | 10 | 28 | 137 | 1063 | 3 | 15 | 6 | 6 | 3 | 116 | 523 |
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| 5 | 20 | 4 | 67 | 47 | 915 | 256 | 24 | 6 | 24 | 20 | 27 | 703 | 184 | 17 | 7 | 1154 | 46 | 11 | 1 | 4 | 3 | 4 | 1099 | 32 |
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| 5 | 21 | 4 | 26 | 28 | 246 | 934 | 5 | 7 | 12 | 9 | 8 | 181 | 781 | 16 | 12 | 334 | 866 | 6 | 3 | 7 | 7 | 3 | 278 | 107 |
| 5 | 21 | 4 | 58 | 64 | 543 | 634 | 13 | 13 | 28 | 27 | 20 | 379 | 453 | 4 | 18 | 116 | 1084 | 2 | 3 | 5 | 2 | 4 | 104 | 794 |
| 5 | 21 | 4 | 42 | 57 | 554 | 623 | 10 | 11 | 27 | 20 | 25 | 432 | 452 | 8 | 6 | 1103 | 97 | 3 | 2 | 5 | 4 | 3 | 1073 | 81 |
| 5 | 21 | 4 | 74 | 71 | 643 | 537 | 14 | 14 | 33 | 23 | 25 | 461 | 417 | 8 | 9 | 208 | 992 | 2 | 2 | 5 | 5 | 3 | 166 | 964 |
| 6 | 1 | 0 | 546 | 220 | 701 | 491 | 19 | 19 | 86 | 285 | 105 | 312 | 236 | 397 | 130 | 873 | 327 | 11 | 10 | 46 | 170 | 59 | 214 | 139 |
| 6 | 1 | 0 | 471 | 205 | 671 | 500 | 18 | 18 | 69 | 236 | 102 | 311 | 249 | 297 | 106 | 737 | 463 | 16 | 15 | 45 | 157 | 61 | 335 | 257 |
| 6 | 1 | 0 | 417 | 155 | 700 | 487 | 16 | 17 | 54 | 189 | 75 | 314 | 298 | 130 | 19 | 1043 | 157 | 7 | 5 | 11 | 37 | 12 | 127 | 127 |
| 6 | 1 | 0 | 519 | 233 | 663 | 529 | 19 | 19 | 72 | 263 | 97 | 300 | 248 | 137 | 43 | 940 | 260 | 9 | 10 | 18 | 61 | 24 | 167 | 189 |
| 6 | 1 | 0 | 542 | 206 | 715 | 478 | 19 | 18 | 76 | 264 | 105 | 320 | 257 | 210 | 67 | 938 | 262 | 10 | 10 | 26 | 85 | 37 | 186 | 176 |
| 6 | 2 | 0 | 120 | 69 | 353 | 832 | 9 | 9 | 25 | 71 | 26 | 224 | 177 | 38 | 10 | 1018 | 182 | 4 | 3 | 7 | 20 | 5 | 61 | 64 |
| 6 | 2 | 0 | 353 | 191 | 606 | 578 | 17 | 17 | 60 | 211 | 64 | 340 | 223 | 94 | 78 | 483 | 717 | 7 | 4 | 17 | 51 | 23 | 382 | 42 |
| 6 | 2 | 0 | 373 | 234 | 581 | 610 | 17 | 19 | 65 | 233 | 74 | 304 | 212 | 178 | 90 | 814 | 386 | 11 | 9 | 25 | 92 | 34 | 257 | 108 |
| 6 | 2 | 0 | 304 | 133 | 740 | 446 | 14 | 14 | 44 | 158 | 55 | 268 | 189 | 123 | 78 | 275 | 925 | 9 | 9 | 21 | 72 | 27 | 143 | 141 |
| 6 | 2 | 0 | 333 | 207 | 605 | 582 | 20 | 20 | 60 | 193 | 82 | 326 | 238 | 182 | 122 | 617 | 583 | 13 | 14 | 29 | 90 | 41 | 249 | 261 |
| 6 | 4 | 2 | 254 | 292 | 390 | 804 | 15 | 16 | 54 | 182 | 111 | 229 | 205 | 65 | 65 | 684 | 516 | 7 | 5 | 13 | 46 | 22 | 635 | 78 |
| 6 | 4 | 2 | 74 | 68 | 1008 | 179 | 5 | 4 | 13 | 49 | 22 | 963 | 95 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1201 | 0 |
| 6 | 4 | 2 | 221 | 171 | 361 | 825 | 11 | 13 | 40 | 134 | 61 | 186 | 221 | 0 | 3 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 4 | 2 | 233 | 221 | 700 | 484 | 12 | 11 | 43 | 151 | 72 | 203 | 149 | 0 | 1 | 68 | 1132 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 6 | 4 | 2 | 356 | 474 | 245 | 940 | 14 | 14 | 65 | 212 | 129 | 37 | 194 | 3 | 149 | 4 | 1196 | 0 | 1 | 6 | 3 | 8 | 0 | 15 |

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| 6 | 6 | 2 | 533 | 267 | 703 | 490 | 18 | 16 | 84 | 265 | 149 | 280 | 251 | 340 | 113 | 786 | 414 | 13 | 14 | 40 | 133 | 74 | 240 | 267 |
| 6 | 6 | 2 | 621 | 295 | 720 | 468 | 18 | 19 | 90 | 308 | 183 | 240 | 233 | 374 | 96 | 799 | 401 | 17 | 16 | 40 | 126 | 65 | 311 | 285 |
| 6 | 6 | 2 | 643 | 266 | 702 | 487 | 17 | 18 | 92 | 297 | 160 | 255 | 222 | 269 | 69 | 906 | 294 | 12 | 11 | 33 | 103 | 47 | 214 | 204 |
| 6 | 6 | 2 | 609 | 223 | 778 | 408 | 19 | 18 | 82 | 261 | 149 | 292 | 185 | 328 | 69 | 960 | 240 | 10 | 11 | 30 | 77 | 49 | 191 | 154 |
| 6 | 6 | 2 | 575 | 223 | 706 | 487 | 18 | 20 | 84 | 264 | 144 | 309 | 265 | 218 | 52 | 577 | 623 | 10 | 9 | 25 | 75 | 38 | 182 | 557 |
| 6 | 7 | 4 | 508 | 205 | 661 | 504 | 18 | 17 | 75 | 238 | 126 | 237 | 308 | 132 | 54 | 427 | 773 | 7 | 9 | 23 | 71 | 34 | 165 | 282 |
| 6 | 7 | 4 | 478 | 197 | 710 | 462 | 20 | 17 | 69 | 225 | 120 | 295 | 248 | 365 | 106 | 884 | 316 | 12 | 13 | 44 | 120 | 61 | 188 | 200 |
| 6 | 7 | 4 | 500 | 190 | 711 | 484 | 18 | 19 | 68 | 219 | 108 | 272 | 296 | 396 | 93 | 781 | 419 | 13 | 14 | 41 | 132 | 59 | 234 | 305 |
| 6 | 7 | 4 | 674 | 294 | 676 | 510 | 17 | 19 | 92 | 318 | 151 | 204 | 235 | 506 | 182 | 749 | 451 | 16 | 16 | 66 | 236 | 109 | 277 | 270 |
| 6 | 7 | 4 | 685 | 227 | 770 | 416 | 19 | 18 | 86 | 282 | 136 | 239 | 209 | 487 | 114 | 808 | 392 | 13 | 13 | 56 | 181 | 63 | 219 | 160 |
| 6 | 8 | 4 | 332 | 368 | 497 | 695 | 18 | 17 | 77 | 242 | 100 | 195 | 233 | 217 | 438 | 306 | 894 | 15 | 16 | 60 | 175 | 82 | 158 | 256 |
| 6 | 8 | 4 | 478 | 328 | 535 | 665 | 18 | 20 | 88 | 312 | 138 | 220 | 288 | 239 | 259 | 451 | 749 | 17 | 17 | 62 | 179 | 81 | 238 | 360 |
| 6 | 8 | 4 | 427 | 303 | 529 | 657 | 19 | 19 | 87 | 288 | 121 | 227 | 264 | 199 | 227 | 338 | 862 | 13 | 15 | 49 | 146 | 56 | 163 | 289 |
| 6 | 8 | 4 | 490 | 302 | 535 | 647 | 17 | 19 | 93 | 321 | 129 | 212 | 232 | 292 | 207 | 551 | 649 | 17 | 15 | 57 | 196 | 78 | 227 | 286 |
| 6 | 8 | 4 | 406 | 284 | 479 | 698 | 18 | 20 | 76 | 274 | 110 | 192 | 333 | 321 | 272 | 417 | 783 | 18 | 18 | 68 | 235 | 95 | 222 | 331 |
| 6 | 9 | 6 | 716 | 212 | 837 | 355 | 20 | 20 | 76 | 267 | 128 | 295 | 161 | 557 | 185 | 828 | 372 | 18 | 19 | 70 | 232 | 105 | 295 | 168 |
| 6 | 9 | 6 | 620 | 254 | 739 | 454 | 18 | 20 | 77 | 281 | 123 | 234 | 217 | 624 | 189 | 768 | 432 | 17 | 18 | 77 | 288 | 97 | 278 | 220 |
| 6 | 9 | 6 | 547 | 273 | 766 | 425 | 18 | 17 | 78 | 289 | 129 | 251 | 179 | 550 | 213 | 774 | 426 | 17 | 18 | 72 | 262 | 93 | 252 | 183 |
| 6 | 9 | 6 | 568 | 216 | 807 | 387 | 19 | 19 | 75 | 257 | 122 | 277 | 170 | 513 | 161 | 869 | 331 | 19 | 17 | 67 | 231 | 98 | 330 | 154 |
| 6 | 9 | 6 | 628 | 215 | 820 | 364 | 18 | 17 | 78 | 279 | 132 | 273 | 159 | 546 | 201 | 792 | 408 | 18 | 21 | 73 | 254 | 103 | 292 | 192 |
| 6 | 10 | 6 | 271 | 272 | 624 | 562 | 17 | 16 | 64 | 194 | 97 | 286 | 242 | 46 | 37 | 969 | 231 | 3 | 5 | 12 | 31 | 10 | 61 | 128 |
| 6 | 10 | 6 | 303 | 299 | 548 | 642 | 19 | 19 | 62 | 207 | 107 | 270 | 295 | 137 | 152 | 371 | 829 | 11 | 11 | 31 | 89 | 43 | 217 | 234 |
| 6 | 10 | 6 | 410 | 277 | 557 | 631 | 19 | 20 | 75 | 254 | 115 | 231 | 333 | 235 | 169 | 540 | 660 | 16 | 16 | 44 | 147 | 69 | 215 | 381 |
| 6 | 10 | 6 | 426 | 369 | 547 | 638 | 18 | 20 | 82 | 282 | 129 | 228 | 278 | 182 | 250 | 447 | 753 | 15 | 16 | 51 | 134 | 72 | 273 | 395 |
| 6 | 10 | 6 | 295 | 280 | 549 | 640 | 17 | 18 | 69 | 213 | 108 | 304 | 318 | 173 | 327 | 395 | 805 | 14 | 15 | 53 | 130 | 69 | 247 | 385 |
| 6 | 11 | 6 | 498 | 279 | 780 | 412 | 32 | 9 | 86 | 313 | 118 | 279 | 163 | 425 | 349 | 751 | 449 | 32 | 7 | 81 | 282 | 116 | 303 | 155 |
| 6 | 11 | 6 | 470 | 318 | 737 | 449 | 32 | 10 | 92 | 330 | 131 | 263 | 170 | 415 | 388 | 664 | 536 | 29 | 7 | 90 | 296 | 130 | 261 | 188 |
| 6 | 11 | 6 | 481 | 340 | 791 | 395 | 35 | 7 | 91 | 311 | 135 | 305 | 125 | 394 | 344 | 699 | 501 | 31 | 9 | 76 | 263 | 107 | 283 | 219 |
| 6 | 11 | 6 | 539 | 366 | 742 | 447 | 32 | 9 | 98 | 335 | 146 | 233 | 142 | 374 | 318 | 741 | 459 | 30 | 7 | 76 | 246 | 108 | 304 | 196 |
| 6 | 11 | 6 | 550 | 381 | 797 | 395 | 33 | 7 | 94 | 356 | 148 | 297 | 118 | 337 | 213 | 826 | 374 | 31 | 9 | 60 | 203 | 86 | 447 | 187 |
| 6 | 12 | 6 | 157 | 423 | 197 | 988 | 9 | 30 | 38 | 123 | 64 | 84 | 472 | 47 | 212 | 137 | 1063 | 5 | 29 | 15 | 36 | 25 | 75 | 719 |
| 6 | 12 | 6 | 87 | 491 | 128 | 1059 | 6 | 29 | 26 | 73 | 42 | 75 | 515 | 34 | 232 | 139 | 1061 | 6 | 25 | 16 | 28 | 20 | 102 | 610 |
| 6 | 12 | 6 | 111 | 479 | 155 | 1030 | 7 | 27 | 32 | 92 | 54 | 83 | 540 | 83 | 339 | 159 | 1041 | 7 | 26 | 25 | 66 | 36 | 96 | 600 |
| 6 | 12 | 6 | 75 | 462 | 154 | 1032 | 6 | 27 | 30 | 65 | 47 | 98 | 506 | 54 | 384 | 206 | 994 | 5 | 19 | 20 | 47 | 26 | 154 | 445 |
| 6 | 12 | 6 | 78 | 494 | 131 | 1054 | 5 | 26 | 26 | 62 | 32 | 64 | 531 | 61 | 452 | 137 | 1063 | 6 | 24 | 24 | 54 | 32 | 95 | 576 |
| 6 | 13 | 6 | 112 | 45 | 1030 | 139 | 21 | 2 | 18 | 41 | 16 | 741 | 70 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 | 0 |
| 6 | 13 | 6 | 108 | 36 | 1055 | 115 | 18 | 1 | 16 | 29 | 17 | 312 | 38 | 1 | 0 | 1200 | 0 | 1 | 0 | 0 | 0 | 0 | 1196 | 0 |
| 6 | 13 | 6 | 191 | 95 | 1018 | 161 | 27 | 2 | 27 | 49 | 26 | 358 | 44 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 13 | 6 | 180 | 71 | 1029 | 161 | 19 | 3 | 26 | 66 | 23 | 283 | 78 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 13 | 6 | 134 | 49 | 1036 | 146 | 24 | 2 | 20 | 27 | 22 | 684 | 66 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 | 0 |

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| 6 | 14 | 6 | 53 | 366 | 107 | 1083 | 4 | 31 | 36 | 42 | 47 | 48 | 615 | 11 | 57 | 19 | 1181 | 1 | 10 | 8 | 10 | 8 | 9 | 242 |
| 6 | 14 | 6 | 19 | 292 | 36 | 1152 | 2 | 33 | 10 | 17 | 13 | 19 | 696 | 7 | 93 | 17 | 1183 | 1 | 7 | 6 | 6 | 8 | 10 | 202 |
| 6 | 14 | 6 | 11 | 235 | 32 | 1157 | 2 | 26 | 6 | 9 | 10 | 18 | 550 | 0 | 25 | 0 | 1200 | 0 | 2 | 0 | 0 | 0 | 0 | 67 |
| 6 | 14 | 6 | 39 | 381 | 60 | 1129 | 3 | 23 | 20 | 36 | 28 | 30 | 466 | 1 | 46 | 1 | 1199 | 0 | 3 | 2 | 1 | 1 | 0 | 81 |
| 6 | 14 | 6 | 21 | 335 | 37 | 1151 | 2 | 33 | 16 | 19 | 22 | 22 | 618 | 0 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 15 | 6 | 269 | 322 | 695 | 489 | 30 | 7 | 74 | 143 | 107 | 290 | 165 | 130 | 240 | 541 | 659 | 22 | 4 | 49 | 60 | 79 | 282 | 118 |
| 6 | 15 | 6 | 277 | 248 | 714 | 468 | 31 | 7 | 68 | 136 | 94 | 314 | 188 | 95 | 143 | 568 | 632 | 24 | 7 | 35 | 33 | 43 | 297 | 203 |
| 6 | 15 | 6 | 231 | 235 | 709 | 480 | 30 | 8 | 58 | 99 | 68 | 314 | 209 | 48 | 84 | 814 | 386 | 12 | 3 | 20 | 26 | 24 | 723 | 75 |
| 6 | 15 | 6 | 229 | 263 | 693 | 498 | 32 | 8 | 66 | 110 | 85 | 299 | 190 | 81 | 224 | 437 | 763 | 18 | 3 | 41 | 37 | 64 | 241 | 92 |
| 6 | 15 | 6 | 240 | 348 | 643 | 540 | 30 | 7 | 70 | 119 | 85 | 270 | 186 | 104 | 137 | 780 | 420 | 25 | 7 | 38 | 36 | 38 | 539 | 227 |
| 6 | 16 | 4 | 173 | 221 | 704 | 483 | 28 | 8 | 46 | 63 | 69 | 318 | 168 | 61 | 66 | 903 | 297 | 14 | 3 | 12 | 12 | 17 | 244 | 70 |
| 6 | 16 | 4 | 144 | 194 | 708 | 460 | 28 | 6 | 44 | 51 | 62 | 352 | 128 | 111 | 149 | 666 | 534 | 18 | 5 | 31 | 32 | 44 | 269 | 110 |
| 6 | 16 | 4 | 131 | 162 | 632 | 552 | 25 | 6 | 36 | 36 | 46 | 304 | 118 | 71 | 98 | 917 | 283 | 18 | 4 | 24 | 24 | 31 | 663 | 104 |
| 6 | 16 | 4 | 188 | 210 | 771 | 420 | 26 | 6 | 53 | 60 | 86 | 321 | 149 | 51 | 81 | 498 | 702 | 13 | 4 | 20 | 22 | 31 | 382 | 537 |
| 6 | 16 | 4 | 188 | 226 | 731 | 455 | 29 | 5 | 53 | 80 | 74 | 343 | 112 | 74 | 68 | 985 | 215 | 14 | 4 | 19 | 29 | 23 | 782 | 80 |
| 6 | 17 | 4 | 46 | 364 | 176 | 1023 | 7 | 19 | 29 | 29 | 42 | 98 | 319 | 18 | 101 | 218 | 982 | 2 | 11 | 12 | 12 | 13 | 19 | 195 |
| 6 | 17 | 4 | 67 | 453 | 173 | 1018 | 8 | 25 | 30 | 44 | 43 | 80 | 427 | 21 | 188 | 44 | 1156 | 3 | 16 | 12 | 16 | 13 | 19 | 268 |
| 6 | 17 | 4 | 30 | 277 | 100 | 1085 | 4 | 25 | 22 | 20 | 33 | 49 | 413 | 17 | 95 | 46 | 1154 | 1 | 2 | 7 | 9 | 5 | 11 | 27 |
| 6 | 17 | 4 | 31 | 258 | 118 | 1067 | 4 | 20 | 18 | 24 | 20 | 68 | 312 | 4 | 153 | 29 | 1171 | 2 | 12 | 4 | 2 | 6 | 18 | 232 |
| 6 | 17 | 4 | 31 | 291 | 214 | 975 | 7 | 21 | 20 | 24 | 27 | 168 | 300 | 4 | 105 | 90 | 1110 | 1 | 11 | 6 | 3 | 6 | 74 | 175 |
| 6 | 18 | 4 | 271 | 219 | 907 | 277 | 36 | 5 | 56 | 96 | 124 | 454 | 94 | 293 | 305 | 902 | 298 | 37 | 3 | 72 | 102 | 164 | 399 | 47 |
| 6 | 18 | 4 | 176 | 140 | 1004 | 183 | 21 | 3 | 36 | 54 | 83 | 247 | 66 | 20 | 22 | 1186 | 14 | 2 | 0 | 5 | 10 | 15 | 18 | 0 |
| 6 | 18 | 4 | 366 | 212 | 923 | 221 | 35 | 4 | 64 | 137 | 133 | 395 | 60 | 211 | 197 | 908 | 292 | 34 | 5 | 51 | 92 | 111 | 539 | 116 |
| 6 | 18 | 4 | 156 | 182 | 955 | 245 | 36 | 3 | 38 | 54 | 85 | 565 | 68 | 109 | 200 | 984 | 216 | 18 | 1 | 36 | 44 | 70 | 350 | 32 |
| 6 | 18 | 4 | 280 | 253 | 908 | 277 | 35 | 3 | 57 | 95 | 122 | 439 | 71 | 98 | 148 | 939 | 261 | 23 | 4 | 30 | 36 | 60 | 679 | 98 |
| 6 | 19 | 4 | 9 | 411 | 37 | 1147 | 2 | 28 | 6 | 7 | 7 | 22 | 557 | 2 | 91 | 29 | 1171 | 1 | 15 | 2 | 1 | 1 | 22 | 379 |
| 6 | 19 | 4 | 17 | 539 | 60 | 1121 | 4 | 26 | 12 | 13 | 16 | 34 | 506 | 4 | 215 | 14 | 1186 | 1 | 10 | 2 | 3 | 3 | 9 | 231 |
| 6 | 19 | 4 | 9 | 467 | 47 | 1136 | 3 | 30 | 6 | 6 | 8 | 31 | 590 | 11 | 330 | 41 | 1159 | 3 | 31 | 6 | 8 | 9 | 24 | 740 |
| 6 | 19 | 4 | 8 | 162 | 66 | 1110 | 2 | 9 | 6 | 5 | 8 | 20 | 188 | 0 | 27 | 0 | 1200 | 0 | 6 | 0 | 0 | 0 | 0 | 171 |
| 6 | 19 | 4 | 18 | 368 | 54 | 1130 | 3 | 26 | 8 | 13 | 12 | 33 | 520 | 8 | 148 | 57 | 1143 | 2 | 15 | 4 | 2 | 5 | 34 | 326 |
| 6 | 20 | 4 | 183 | 112 | 875 | 306 | 28 | 7 | 36 | 47 | 54 | 362 | 158 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | 20 | 4 | 162 | 152 | 908 | 279 | 31 | 5 | 32 | 34 | 60 | 426 | 106 | 3 | 0 | 1200 | 0 | 1 | 0 | 0 | 0 | 0 | 13 | 0 |
| 6 | 20 | 4 | 258 | 368 | 838 | 347 | 30 | 6 | 48 | 55 | 131 | 290 | 119 | 51 | 111 | 965 | 235 | 15 | 3 | 14 | 11 | 25 | 732 | 68 |
| 6 | 20 | 4 | 138 | 232 | 835 | 340 | 26 | 7 | 29 | 34 | 66 | 337 | 159 | 77 | 157 | 580 | 620 | 19 | 3 | 19 | 17 | 32 | 192 | 77 |
| 6 | 20 | 4 | 228 | 197 | 800 | 380 | 30 | 6 | 51 | 69 | 68 | 330 | 139 | 129 | 179 | 748 | 452 | 23 | 8 | 36 | 41 | 53 | 295 | 230 |
| 6 | 21 | 4 | 98 | 329 | 384 | 796 | 14 | 13 | 36 | 53 | 43 | 242 | 293 | 38 | 235 | 226 | 974 | 9 | 11 | 18 | 24 | 24 | 163 | 273 |
| 6 | 21 | 4 | 63 | 312 | 347 | 826 | 13 | 13 | 28 | 36 | 53 | 238 | 312 | 22 | 162 | 99 | 1101 | 5 | 3 | 12 | 13 | 20 | 58 | 97 |
| 6 | 21 | 4 | 87 | 250 | 408 | 778 | 16 | 17 | 34 | 41 | 57 | 246 | 435 | 52 | 252 | 246 | 954 | 10 | 10 | 24 | 33 | 43 | 155 | 281 |
| 6 | 21 | 4 | 91 | 272 | 430 | 752 | 14 | 14 | 36 | 51 | 54 | 277 | 294 | 13 | 49 | 118 | 1082 | 4 | 5 | 8 | 9 | 12 | 94 | 120 |
| 6 | 21 | 4 | 102 | 234 | 440 | 735 | 15 | 15 | 36 | 55 | 57 | 279 | 352 | 34 | 150 | 194 | 1006 | 8 | 7 | 16 | 21 | 26 | 121 | 208 |
| 7 | 18 | 4 | 256 | 85 | 1006 | 182 | 31 | 5 | 38 | 82 | 57 | 601 | 91 | 182 | 129 | 963 | 237 | 30 | 4 | 52 | 102 | 81 | 693 | 76 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | 18 | 4 | 251 | 106 | 1010 | 176 | 30 | 3 | 53 | 108 | 78 | 642 | 66 | 186 | 112 | 983 | 217 | 29 | 3 | 43 | 97 | 68 | 716 | 98 |
| 7 | 18 | 4 | 186 | 74 | 1028 | 168 | 23 | 3 | 32 | 73 | 52 | 760 | 75 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 1200 | 0 |
| 7 | 18 | 4 | 244 | 98 | 996 | 204 | 29 | 4 | 55 | 107 | 72 | 635 | 84 | 84 | 70 | 1058 | 142 | 16 | 2 | 28 | 41 | 44 | 345 | 59 |
| 7 | 18 | 4 | 155 | 67 | 800 | 160 | 25 | 4 | 28 | 57 | 42 | 577 | 97 | 124 | 54 | 1086 | 114 | 26 | 3 | 30 | 50 | 39 | 856 | 47 |
| 7 | 19 | 4 | 47 | 149 | 123 | 1071 | 3 | 30 | 18 | 33 | 29 | 76 | 501 | 14 | 29 | 12 | 1188 | 0 | 3 | 4 | 9 | 9 | 0 | 21 |
| 7 | 19 | 4 | 63 | 110 | 134 | 1059 | 3 | 22 | 20 | 41 | 25 | 76 | 375 | 26 | 78 | 122 | 1078 | 3 | 16 | 8 | 17 | 10 | 89 | 257 |
| 7 | 19 | 4 | 45 | 82 | 108 | 1076 | 2 | 15 | 14 | 27 | 25 | 59 | 279 | 30 | 63 | 89 | 1111 | 2 | 15 | 10 | 22 | 12 | 42 | 296 |
| 7 | 19 | 4 | 69 | 122 | 171 | 753 | 3 | 22 | 23 | 46 | 35 | 83 | 339 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 19 | 4 | 46 | 128 | 87 | 1064 | 2 | 33 | 14 | 32 | 24 | 51 | 633 | 10 | 70 | 76 | 1124 | 2 | 17 | 4 | 8 | 4 | 63 | 271 |
| 7 | 20 | 4 | 133 | 62 | 1014 | 167 | 23 | 5 | 22 | 48 | 44 | 596 | 111 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 20 | 4 | 162 | 70 | 1032 | 154 | 21 | 4 | 30 | 64 | 54 | 541 | 88 | 56 | 17 | 1152 | 48 | 12 | 2 | 8 | 19 | 14 | 331 | 29 |
| 7 | 20 | 4 | 167 | 89 | 1014 | 170 | 26 | 6 | 34 | 81 | 69 | 622 | 97 | 21 | 4 | 1181 | 19 | 9 | 1 | 2 | 4 | 3 | 235 | 14 |
| 7 | 20 | 4 | 107 | 56 | 988 | 156 | 18 | 4 | 28 | 57 | 42 | 410 | 84 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 20 | 4 | 113 | 61 | 1015 | 171 | 22 | 4 | 28 | 49 | 45 | 498 | 104 | 0 | 0 | 1200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | 21 | 4 | 150 | 149 | 730 | 438 | 15 | 15 | 47 | 86 | 87 | 461 | 271 | 158 | 136 | 822 | 378 | 15 | 15 | 45 | 88 | 78 | 588 | 198 |
| 7 | 21 | 4 | 166 | 121 | 772 | 416 | 15 | 16 | 50 | 96 | 78 | 542 | 252 | 210 | 151 | 848 | 352 | 16 | 16 | 59 | 99 | 90 | 520 | 152 |
| 7 | 21 | 4 | 316 | 212 | 965 | 235 | 12 | 12 | 81 | 154 | 133 | 351 | 8 | 195 | 70 | 1110 | 90 | 11 | 9 | 34 | 71 | 56 | 314 | 5 |
| 7 | 21 | 4 | 166 | 123 | 774 | 420 | 16 | 16 | 45 | 80 | 80 | 419 | 259 | 134 | 120 | 797 | 403 | 17 | 18 | 37 | 68 | 70 | 565 | 246 |
| 7 | 21 | 4 | 201 | 192 | 737 | 456 | 16 | 15 | 58 | 125 | 109 | 505 | 255 | 163 | 138 | 842 | 358 | 15 | 15 | 44 | 93 | 80 | 630 | 194 |